Trends in 1958
Car Design
P. 25

SAE Journal

IN THIS ISSUE . . .

TRENDS IN 1958 CAR DESIGN 25

SUPERSONIC TRANSPORTS delayed by switch to missiles. British expert tells why 30

PH STEELS' welding and brazing problems are solved by NEW techniques 37

HYDROCARBON FUELS will continue tops for automotive power 41

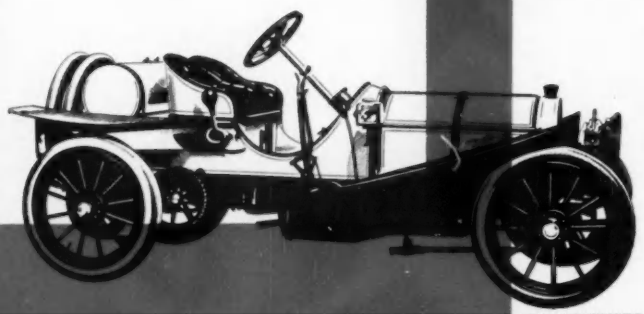
X-RAY INSPECTION SAVES AIRLINERS 53

STEEL CAN BE USED to produce lighter aircraft 56

DECEMBER 1957

Published by The Society of Automotive Engineers

YESTERDAY...



when compression ratios were 3 to 1, any good oil ring would do...as in this rakish Apperson Jack Rabbit, vintage 1907. Guaranteed to turn up 75 miles per hour, the car featured 60 H.P. engine, 4-speed selective type transmission, double ignition with magneto and coil, and carried a price tag of $5,000.

TODAY...



U.S. patents 2,635,022 and 2,695,825

it takes the PC type "98" chrome oil ring!

The Perfect Circle Type "98" Chrome oil ring was specifically designed to meet the exacting demands of today's high-compression engines. Featuring universal application, bottomless and conventional grooves, all depths, the PC Type "98" oil ring was the first to have a patented side-sealing action with multiple tiny springs that exert both side and radial pressure. And of utmost importance, Type "98" Chrome Oil Rings provide maximum oil drainage! Perfect Circle Corporation, Hagerstown, Ind.; The Perfect Circle Co., Ltd., 888 Don Mills Road, Don Mills, Ont.

PERFECT CIRCLE

PISTON RINGS

Preferred by more people than any other brand!

SAE Journal

Pub. Off.: 10 McGovern Ave., Lancaster, Pa.
Ed. Off.: 485 Lexington Ave., New York, N.Y.

Norman G. Shidle, Editor
Eleanor D. Allen, Managing Editor
David L. Staiger, Associate Editor
Otto W. Vathke, Technical Editor
Engineering Editors
Frances L. Weeden
Walter G. Patton, Detroit

Contents • December 1957

READERSHIP RESEARCH

Trends in 1958 Car Design 25

Here are the top engineering news items for 1958: 1. Adoption of dual headlights by virtually the entire industry. 2. Introduction of air suspension as optional equipment by all car producers except two. 3. Lowering of cars by all producers in a position to do so. 4. Adoption of unitized body-and-frame construction by Lincoln.

? ? ? About Supersonic Transports 30

Both the economic and engineering outlooks for supersonic airliners are examined frankly in this article by a leading world authority. Facing the current switch to missiles, he details how and why he arrives at his conclusions. (Paper No. 197a)—**F. R. Banks**

New Test Developed for Gear Oils 32

A NEW full-scale axle technique for testing multipurpose gear lubricants has been developed that combines in a single test both high-speed and high-torque requirements. This test has given good correlation with field tests run by the Ordnance Corps at Yuma, Ariz. in highly loaded vehicles. (CRC-308)

Mating P&W J57 Turbojet to F-102 33

The installation of the P&W J57 turbojet engine with afterburner on the F-102 interceptor has many interesting features, such as the Engine mounting system, Air intake, and Engine shroud. (Paper No. 232)—**R. J. Chillo**

Welding and Brazing the PH Steels 37

Problems encountered in welding and brazing the PH steels include: Cracked welds and low weld-metal ductility, Oxidation of aluminum during welding process, Crevice corrosion of brazed joints, and Unsatisfactory bonds from normal brazing operations. (Paper No. 216)—**F. K. Lampson**

Don't Forget Man 38

For a variety of reasons even automation isn't going to banish the need for human engineering. (Paper No. 183)—**H. J. Bond**

True Vapor Pressure 39

True aviation gasoline vapor pressure can easily be found by combining a simplified test technique with correcting calculations given in CRC Report 290, "Vapor Pressure Relations of Gasolines." (CRC-290)

Looking Ahead in Fuels 41

After reviewing past accomplishments in the field of mutual adaption of fuels and engines, the author predicts that a fuel of predominantly hydrocarbon composition will continue to be most suitable for automotive power. (SP-216)—**J. M. Campbell**

X-Ray Inspection Saves Airliners ... 53

Diffraction and conventional X-ray photographs are used to detect stresses and cracks in the DC-6, DC-7, DC-7B, Convair 340, and 440 airplanes. (Paper No. 223)—**A. D. Edwards**

Handling Flight Test Data 54

A digital data processing system has been designed to handle a portion of the flight test data required to evaluate and demonstrate the Martin YP6M-1 Seamaster. (Paper No. 192)—**H. W. Royce**

Steel Helps Produce Lighter Planes 56

Low weight and high strength are achieved by using steel foil that is stiffened locally with miniature corrugations and by tapering the spar caps to match the load. (Paper No. 210)—**Bruce Mitchell**

To order complete papers on which articles are based, turn to page 5.

Continued on page 2

SAE Journal

Contents • December 1957 • Continued

SAE Looks Overseas **69**

Public demonstration of SNECMA Flying Atar described. How European airlines pool information and parts for mutual benefit.

Three National Meetings **72**

Transportation, Diesel Engine, and Fuels and Lubricants—joined forces on November 4–8, 1957 in Cleveland. The combination meeting was set in a background of the most extensive plant visit program ever fashioned for SAE groups.

Briefs of SAE Papers 5

Jetstar Features Unusual Engine Location 108

Over-100-Octane Ratings Feasible (Paper No. 259) .. 108

Gas Turbine Fuels and Avgas Compared 110

Predicting Vibration Isolator Effectiveness (Paper No. 201) 112

Weapon System Cost Paced by Ground Support (Paper No. 207) 113

Equipment Fragility Reporting Inadequate (Paper No. 196) 115

The SAE Story for December

SAE Section News 78

News of SAE 85

SAE National Meetings Schedule 85

SAE Section Meetings Schedule 85

Announcement of the 1958 SAE Annual Meeting and Engineering Display 86

About SAE Members 88

CEP News 92

Nuclear News Notes 100

New Members Qualified 116

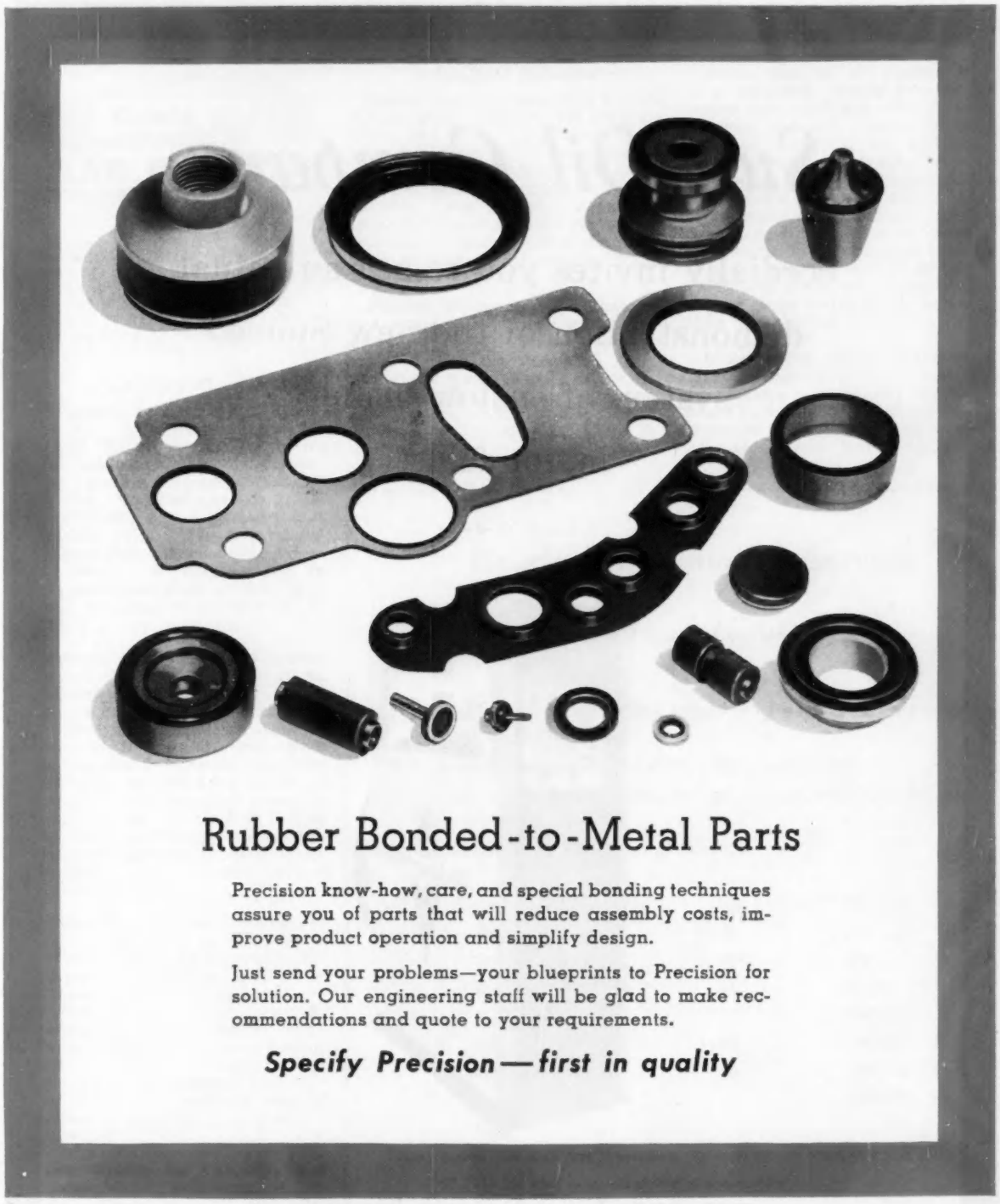
Applications Received 122

Index for SAE Journal—January 1957 through December 1957 207

More on page 1

To order complete papers on which articles are based, turn to page 5.

SAE JOURNAL, December, 1957, Vol. 65, No. 13. Published monthly except two issues in January by the Society of Automotive Engineers, Inc. Publication office at 10 McGovern Ave., Lancaster, Pa. Editorial and advertising department at the headquarters of the Society, 485 Lexington Ave., New York 17, N. Y. $1 per number; $10 per year; foreign $12 per year; to members 50¢ per number, $5 per year. Entered as second class matter, Sept. 15, 1948, at the Post Office at Lancaster, Pa., under the act of Aug. 24, 1912. Acceptance for mailing at special rate of postage provided for in the Act of Feb. 28, 1925, embodied in paragraph (d-2), Sec. 34.40, P. L. and R., of 1918. Additional entry at New York, N. Y.



Rubber Bonded-to-Metal Parts

Precision know-how, care, and special bonding techniques assure you of parts that will reduce assembly costs, improve product operation and simplify design.

Just send your problems—your blueprints to Precision for solution. Our engineering staff will be glad to make recommendations and quote to your requirements.

Specify Precision—first in quality

Precision Rubber Products Corporation

"O" Ring and Dyna-seal Specialists

3110 Oakridge Drive, Dayton 7, Ohio

Canadian plant at: Ste. Thèrése de Blainville, Québec

Sun Oil Company

cordially invites you to see an actual demonstration of the new Sunoco system of custom-blended motor fuels.



THE TIME: January 13 through January 17, 1958

THE PLACE: Sheraton-Cadillac Hotel, Detroit—English Room, Booth 101

Briefs of SAE PAPERS

Presented below are brief digests of recently presented SAE papers. These papers are available in full in multilith form for one year after presentation. To order, circle the numbers in the "Readers Information Service" blank at right corresponding to the numbers appearing after the titles of the digests of interest to you.

AIRCRAFT

Subcommittee on Receivers Report. Paper No. 195 presented Sept.–Oct. 1957, 22 p. Report consists of following papers: **Statistical Method for Determining Vibration Damage to Airborne Equipment, H. HIMELBLAU, Jr. K. KUOPPAMAKI, E. H. LAHNALA, F. B. SAFFORD,** 11 p; **Equipment Rigid-Body Properties for Providing Vibration Protection, H. HIMELBLAU, Jr.** 6 p; **Optimum Selection of Reed Gage Natural Frequencies, F. MINTZ, H. HIMELBLAU, Jr.** 5 p.

Describing Aircraft as Vibration Source, W. W. HARTER. Paper No. 194 presented Sept.–Oct. 1957 7 p. Subcommittee on Sources was formed by S-12 Shock and Vibration Committee to determine most suitable method for presenting source vibration data; approach taken for describing aircraft as discrete frequency vibration source; it appears that data in form of free or unloaded velocities and mechanical impedances offer greatest potential utility in designing equipment installations; numerical example.

Application of Digital Computer to Aircraft Route Analyses, A. C. BUTTERWORTH, G. E. HULL. Paper No. 193 presented Sept.–Oct. 1957 12 p. How Douglas Aircraft Co performs airplane route analysis on high speed digital computers; basic operating problem and reasons for its complication; parameters involved in computation; specific operational variables, and computing procedures; methods used in programming computer to achieve results desired.

Digital System for Collecting and Processing Flight Test Data, H. W. ROYCE. Paper No. 192 presented Sept.–Oct. 1957 4 p. Use of techniques at Martin Co, Baltimore; airborne data processing system, designed to handle portion of flight test data required to evaluate and demonstrate YP6M-1 Seamaster, records slowly changing data on quasi static measurements and is capable of sampling up to 1000 measurements once each per second; description of ground based data editing and processing system; collection of calibration data.

GROUND VEHICLES

Torque Converting the Farm Tractor, E. E. EATON. Paper No. 188 presented Sept. 1957 11 p. Practicability of torque converter application and its relationship to operating characteristics; typical performance curve of converter; lock up clutch to increase efficiency; use of capacity curves; application of basic converter characteristics to tractor performance; future possibilities.

Wanted: Product Design Engineers, C. J. SCRANTON. Paper No. 187 presented Sept. 1957 5 p. Subject is approached from five viewpoints: What does industry expect of Graduate Engineer; what may graduate expect from industry; characteristics of good product engineer; objectives in product design; and future in product engineering.

Stress Analysis of Tractor Parts, E. J. ECKERT. Paper No. 186 presented Sept. 1957 4 p. Use of brittle lacquers and wire resistance strain gages at Caterpillar Tractor Laboratory to determine operating loads and stresses in parts such as rear axle, rear wheel, track link, and engine rocker arm; nonresonant fatigue machine used to determine effect of variations in material, heat treatment, geometry of spline and surface treatment on strength of shaft; correlation between data obtained during actual field operation and laboratory setups.

Experimental Stress Analysis of Tractors and Allied Equipment—Field Applications of Stresscoat and Strain Gages L. A. GROTTO. Paper No. 185 presented Sept. 1957 7 p. Since sensitivity of stresscoat depends upon grade

Continued on page 6

Readers' Information Service

SAE Papers Available

- Papers on which December SAE Journal articles are based are available in full in multilith form.
- Paper numbers are indicated at the END of each article.
- CIRCLE THE NUMBERS (BELOW) OF THE PAPERS DESIRED, and indicate number of copies.
- ORDER BLANK is on the back of this form.

S16	185	195	223
154	186	196	232
155	187	197A	259
168	188	201	SP-216
172A	192	207	CRC-290
183	193	210	CRC-308
184	194	216	CRC-310
			CRC-311

Prices: Papers—50¢ each copy to members; 75¢ each copy to nonmembers.
SP-216—50¢ each to members; 75¢ to nonmembers.
CRC-290—$4.00 each to members; $8.00 to nonmembers.
CRC-308—$1.00 each to members; $2.00 to nonmembers.
CRC-310—$2.00 each to members; $4.00 to nonmembers.
CRC-311—$2.00 each to members; $4.00 to nonmembers.

- ADVERTISERS in this issue will supply further information to inquirers who circle PAGE NUMBERS ON THE BACK OF THIS FORM.

Briefs of SAE PAPERS

Continued from page 5

of coating and temperature and humidity of test environment, techniques were developed so that stresscoat and strain gages could be used anywhere; summer and winter technique for stresscoating and typical results; installation of strain gages, instrumentation and recording units used by International Harvester for testing tractors.

Experimental Stress Analysis of Tractors and Allied Equipment—Description and Instrumentation, D. J. WARD. Paper No. 184 presented Sept. 1957 4 p. In initial design of any crawler tractor part, assumptions must be made as to maximum load to be absorbed, its distribution and effect; by use of Stresscoat and strain gages, designed part can be analyzed and stress pattern determined; procedure for using Stresscoat; type and features of strain gages used; instruments to measure change of electrical resistance in gage; application of stress analysis techniques.

Grab Sampling and Analysis Techniques for Engine Exhaust Gas, B. M. STURGIS. Paper No. 172 A presented Aug. 1957 11 p. Progress report of Sampling and Analysis Panel of CFR Group; report on techniques for obtaining samples of exhaust gases and analyzing them for determination of total organics, oxides of nitrogen, carbon monoxide, carbon dioxide, water, hydrogen, and oxygen.

Determination of Hydrocarbon Emission Rate by Continuous Air Flow Measurement and Exhaust Analysis, J. C. NEERMAN, G. H. MILLAR. Paper No. 168 presented Aug. 1957 21 p. Description of infrared interference filter photometer for measuring and recording concentration of hydrocarbons in exhaust by means of their optical absorption at 3.43 microns; operating procedure and analytical results; viscous air flow meter used to measure and record carburetor intake air flow on moving car; flow meter theory; tables; 36 refs.

Development of Small Aircooled Gasoline Engines, L. J. LECHTENBERG. Paper No. S16 presented Mar. 1957 (Twin City Section) 14 p. Experience with aluminum die cast bearings at Briggs & Stratton, Milwaukee, led to development of aluminum engine for rotary lawnmower applications; tests and data such as amount of cooling air and fin area required for cylinder, vibration characteristics of long vs short stroke engines, material to be used for valve seat inserts, etc; tests to determine durability; range of models developed from basic design.

Air-Cooled Diesel Engine Appraisal, C. F. BACHLE. Paper No. 154. Presented Aug., 1957, 33 p. Air cooling versus liquid cooling is discussed and requirements of combat vehicles outlined; comparison of liquid cooled and air cooled engine principles for military and commercial vehicles; table of average characteristics of air cooled diesel engines for four groups of application; features and illustrations of engine models of various American and European makes.

Automotive Driving Axles and Practical Applications to Various Types, N. R. BROWNYER. Paper No. 155. Presented Aug., 1957, 13 p. Factors to be considered in selection of correct type of axle for use in any given kind of operation; descriptive illustrations of axles, built by Timken Detroit Axle Div. of Rockwell Spring & Axle Co., for on and off road use; planetary axles for truck and industrial applications.

These digests are provided by Engineering Index, which abstracts and classifies material from SAE and 1200 other technical magazines, society transactions, government bulletins, research reports, and the like, throughout the world.

Readers' Information Service

Advertising Information Available

- If you would like further engineering information on any of the products ADVERTISED in this December issue, CIRCLE THE APPROPRIATE PAGE NUMBERS in the list BELOW. Requests will be forwarded to the advertisers.

3	96	115	134	155	175	193
4	97	116 left	135	156	176	194
7	98	116 right	136	157	177	195
8	99	117	138	158	179	196
9	100	118	139	159	180	197
10	101	119	140	160	181	199
11	102	120	141	161	182	200 left
	103	121	142	162	183	200 right
13	104	122	143	163	185	201
14	105	123	144	164	186	202
15	106	124	145	165	187	203
16	107	125		166	188	205
17	108	126	147	167	189	206
18	109	128	148	168	190	
19	110	129	149	169	191	Inside front cover
	111	130	151	170	192 left	Inside back cover
21		131		171	192 right top	Outside back cover
22	113	132	153	172	192 right middle	
24	114	133	154	174	192 right bottom	

ORDER BLANK

TO: Society of Automotive Engineers, Inc.
485 Lexington Ave.

PLEASE SEND ME:

. . . The SAE Papers and Special Publications whose numbers I have circled on the back of this form. PAPERS are 50¢ to members; 75¢ to nonmembers. SP's are priced as indicated on back of this form.

.... Check or coupons enclosed ☐

.... Bill Company .... Bill me

PLEASE SEND ME:

. . . Information about the advertisers' products and services circled above. ☐

NAME .....

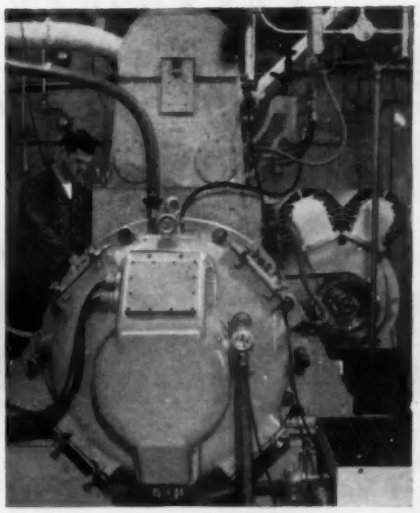
COMPANY .....

COMPANY ADDRESS .....

ND FACTS

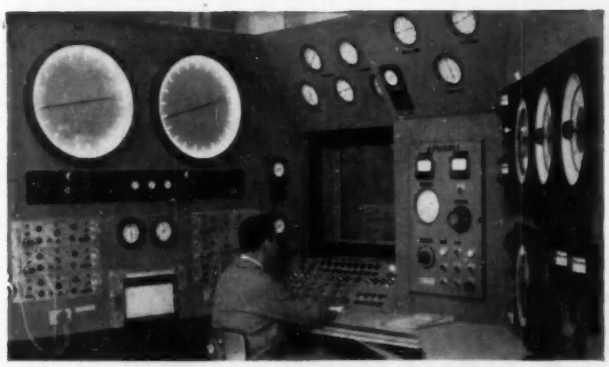


New Departure makes a complete line of jet engine, auxiliary turbine, and accessory bearings for the aircraft industry.



Test stand for running jet engine ball bearings at high speeds, high temperatures under heavily loaded conditions.

RESEARCH NEVER STOPS!



Instrumentation and control console for test stand shown above, for testing full-scale mainshaft ball bearings.

Tomorrow's needs are today's concern at the aircraft ball bearing research facilities at New Departure. For, the future development of the ball bearing will be closely identified with future engine design trends. This means New Departure spares no effort in developing bearings to operate at higher speeds, heavier loads, and under higher temperatures with good bearing-life predictability.

As always, New Departure keeps pace with changing conditions in the industry. For New Departure's design and fabrication processes for current high-speed, high-temperature, heavily loaded ball bearings are major factors in the successful operation of today's jet engines, as well as auxiliary turbines and accessories.

For aircraft and accessory bearings, send for **CATALOG ABC.**

For data on research progress for jet engine bearings, send for **REPRINT JEB.**

1908–1958 GM FORWARD FROM FIFTY

ND NEW DEPARTURE

DIVISION OF GENERAL MOTORS, BRISTOL, CONN.

NOTHING ROLLS LIKE A BALL

GENERAL MOTORS
GOLDEN FIVE for '58

Celebrating General Motors' Golden Milestone Anniversary

FROM THE PROGRESS OF THE PAST

GM

1908 1958

— THE PROMISE OF THE FUTURE



The GM Golden Anniversary Chevrolet



The GM Golden Anniversary Pontiac



The GM Golden Anniversary Oldsmobile



The GM Golden Anniversary Buick



The GM Golden Anniversary Cadillac

The Rim that put Tubeless Tires in this picture

Tru-Seal Rim
by Goodyear



ON jagged rocks, up steep grades, over rutted roads—today you can use tubeless tires almost anywhere—enjoy all the benefits of this great advance in tire construction.

One big reason is the development by Goodyear of the Tru-Seal Rim. This is the rim that has been adopted as standard by the Tire and Rim Association for tubeless replacement of all conventional tire sizes 12:00 and larger.

Tru-Seal is the only practical method yet devised to seal a multiple-piece rim. It adds one more to the many benefits Goodyear's vast tire-building experience brings to rim construction. With Goodyear rims, you profit by such advantages as:

Unusual Strength: Thanks to an exclusive double-welding process, and added support at points of greatest stress, present-day Goodyear Rims are far stronger than previous rims.

Ease of Tire Mounting: No tube and flap troubles.

Special Tools: Goodyear alone provides both hydraulic and hand tools especially made for larger wheel sizes.

Bond-a-Coat Finish: This protective coating affords long-lasting resistance to rust and corrosion.

If you have a rim problem, why not talk it over with the G.R.E. (Goodyear Rim Engineer). He'll save you time and money by helping you select the type and size of rim best suited to your needs. Write him at Goodyear, Metal Products Division, Akron 16, Ohio, or contact your local Goodyear Rim Distributor.

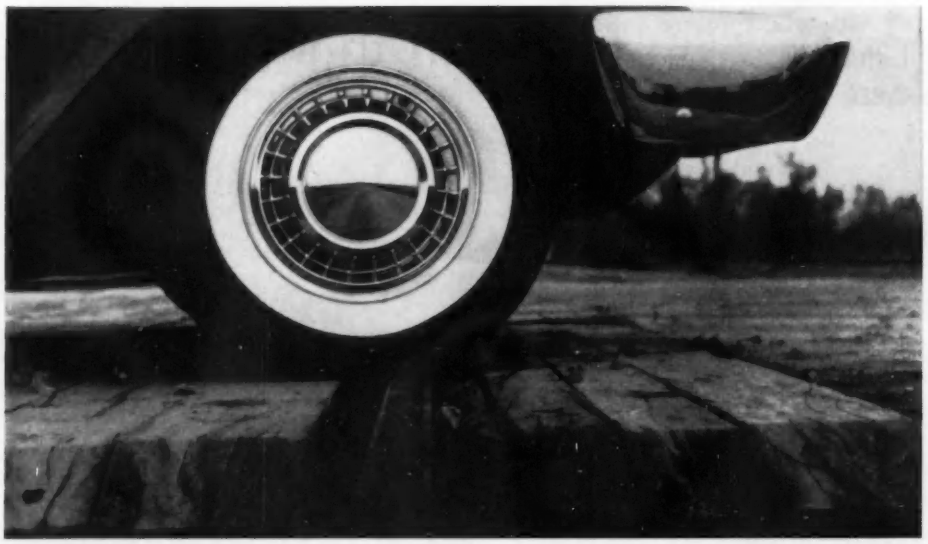


New Tru-Seal Rims – for sizes 12.00 and up, including all earth-mover and grader sizes. This rim is similar to multiple-piece rims now in use—PLUS airtight Tru-Seal rubber ring which compresses into sealing groove when tire is mounted.

Buy and Specify **GOODYEAR**

MORE TONS ARE CARRIED ON GOODYEAR RIMS THAN ON ANY OTHER KIND

Tru-Seal—T.M. The Goodyear Tire & Rubber Company, Akron, Ohio



TORSION-AIRE

• WHAT IT IS • WHAT IT DOES • WHY IT IS BEST FOR YOU

Last year Chrysler Corporation proved that America was ready for something new in the way of ride and handling. And Torsion-Aire has given people just what they wanted!

Torsion-Aire is Chrysler Corporation's name for its rubber-isolated, ball-joint, anti-dip, torsion bar system of suspension. And it's unique among American cars. Its design comes from a fresh start, a clean drawing board. It is based on the belief that piecemeal modifications—and design compromises to accommodate optional suspension elements—are no match for a fully integrated, balanced system designed as a *whole*, with the *whole* car in mind.

As a result, it's *the most advanced suspension system yet developed.* No other gives you *all* these important advantages:

• Torsion-Aire is built right into the car. It's not "added on" or "extra". The Torsion-Aire system of suspension was designed for the car . . . and the car was designed for it.

• Torsion-Aire is a complete system. It is designed "in depth" to eliminate your three biggest handling problems. No more starting squat. No more sway on turns. No more braking nose-dive.

• Torsion-Aire is standard equipment on *all Chrysler Corporation Cars*—and at no extra cost. Suspension isn't an accessory you can take or do without. It's as basic to the car as wheels.

• Torsion-Aire is a proven system. Unlike untried systems, Torsion-Aire has been proved by billions of passenger car miles—by more than a million satisfied owners.

Want more proof of Torsion-Aire superiority? Take the Torsion-Aire road test. You don't have to seek out special conditions. With a bump in almost any block—and a corner at the end of it—you can prove this new kind of ride to yourself in the first quarter mile!

CHRYSLER CORPORATION — **THE *FORWARD* LOOK**

PLYMOUTH • DODGE • DE SOTO • CHRYSLER • IMPERIAL

Automatic transmission seal problem—

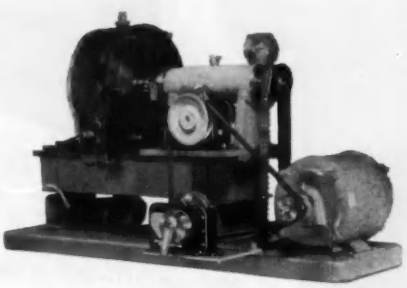


New National Syntech® proves dependable answer in front pump seal position

Constant temperatures of 250°F, peaks of 300°, continual change in shaft speed, and total inaccessibility of the seal without costly teardown—these are a few of the sealing problems in the front pump of today's automatic transmissions for passenger cars.

To help meet this challenge, National engineers have produced a new oil seal. The new design, a steel encased, spring-loaded unit with Syntech synthetic sealing lip, is characterized by an unusually long flex section in the lip, a special, light-loading tension spring, and the time-tested, low torque Syntech lip itself.

Factory engineers report that the new National seals are proving extremely reliable in the application. Dealers also find the front pump seals are very reliable and do not require early replacement.



To design and thoroughly test the new seal, National engineers developed a new transmission simulator which exactly duplicates front pump operating conditions at all car speeds.



Get real help on seal engineering problems. Call the National Engineer.

NATIONAL SEAL Division, Federal-Mogul-Bower Bearings, Inc.

General Offices: Redwood City, California; Plants: Van Wert, Ohio, Downey and Redwood City, California



UDT-1091 Turbotorque® Diesel 6-cyl; 5¾ x 7; 1,091 cu. in. displ.; Eng. hp @ 1500 rpm: Max. 300; int. 265; Power Unit Int. load hp —250 @ 1500 rpm



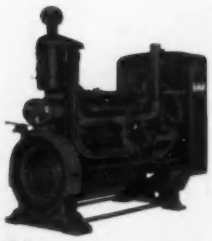
UD-1091 6-cyl Diesel 5¾ x 7; 1,091 cu. in. displ.; Eng. Max. hp—224 @ 1500 rpm; Power Unit Int. load hp—202 @ 1500 rpm



UD-18A 6-cyl Diesel 4¾ x 6½; 691 cu. in. displ.; Eng. Max. hp—150 @ 1600 rpm; Power Unit Int. load hp —125 @ 1600 rpm



U-501 6-cyl Carbureted 4½ x 5¼; 501 cu. in. displ.; Basic Eng. Max. hp: Gaso.—212 @ 3000 rpm; Power Unit Net hp: Gaso. — 133 @ 2200 rpm; LPG—128 @ 2200 rpm



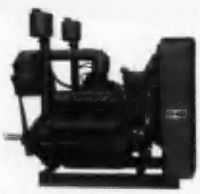
U-450 6-cyl Carbureted 4⅜ x 5; 450 cu. in. displ.; Basic Eng. Max. hp — Gaso. — 182 @ 3000 rpm; Power Unit Net hp: Gaso. — 126 @ 2200 rpm; LPG—124 @ 2200 rpm



U-372 6-cyl Carbureted 4⅜ x 4⅛; 372 cu. in. displ.; Basic Eng. Max. hp—Gaso.—165 @ 3200 rpm; Power Unit Net hp: Gaso. — 104 @ 2200 rpm; LPG—97 @ 2200 rpm



UV-549 V-8-cyl Carbureted 4½ x 4¾; 549 cu. in. displ.; Eng. Max. hp: Gaso. — 257 @ 3400 rpm; Power Unit Net hp: Gaso. — 208 @ 2600 rpm; LPG—201 @ 2600 rpm



UV-461 V-8-cyl Carbureted 4⅛ x 4¾; 461 cu. in. displ.; Eng. Max. hp: Gaso. — 226 @ 3600 rpm; Power Unit Net hp: Gaso. — 169 @ 2600 rpm; LPG—169 @ 2600 rpm

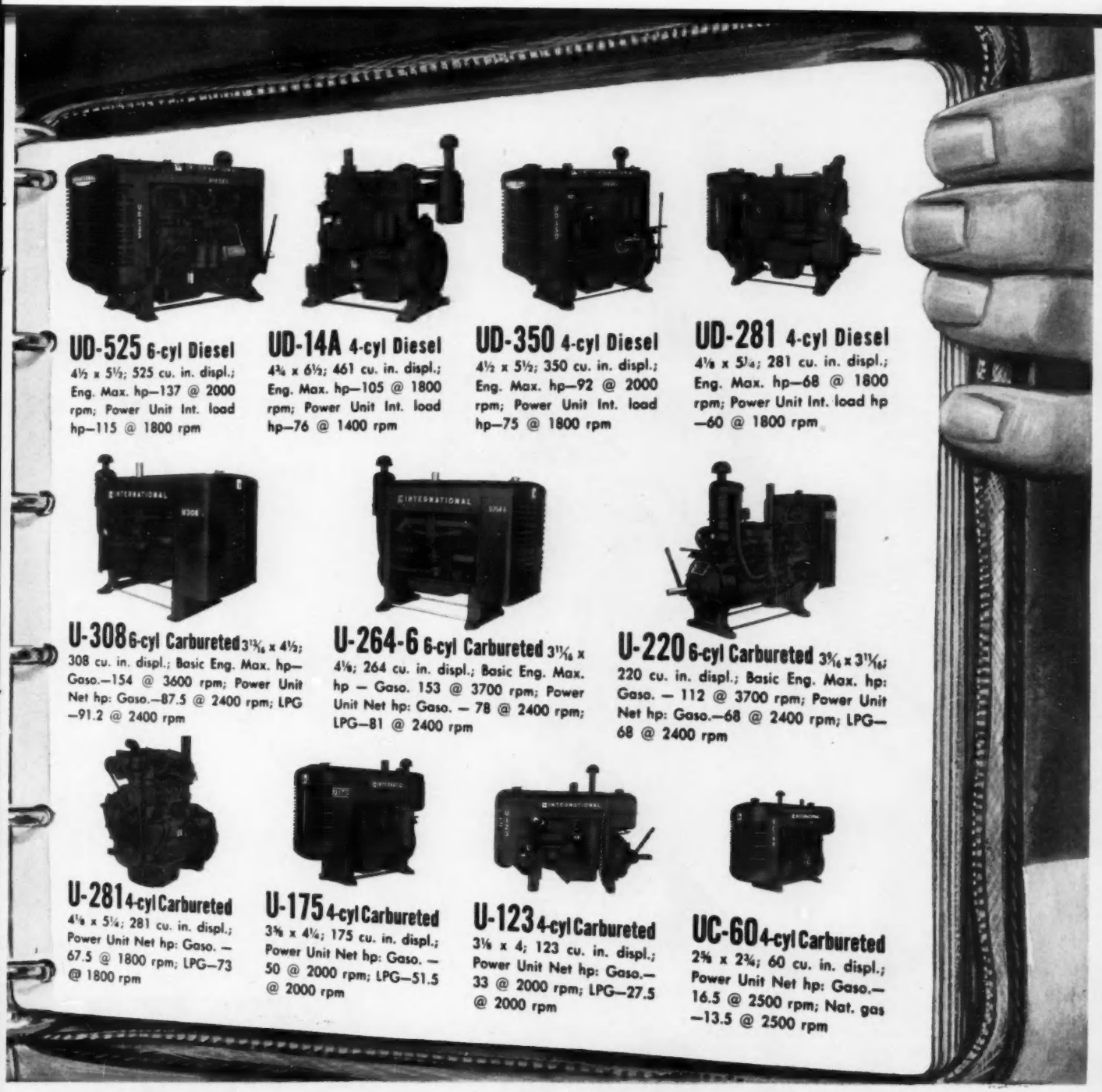


UV-401 V-8-cyl Carbureted 4⅛ x 3¾; 401 cu. in. displ.; Eng. Max. hp—Gaso.—206 @ 3600 rpm; Power Unit Net hp: Gaso. — 155 @ 2800 rpm; LPG—155 @ 2800 rpm

Power that protects your reputation as a specifier!

Call in THE MAN FROM INTERNATIONAL for the full story on 20 heavy-duty industrial engines that deliver a full measure of dependable power





UD-525 6-cyl Diesel
4½ x 5½; 525 cu. in. displ.; Eng. Max. hp—137 @ 2000 rpm; Power Unit Int. load hp—115 @ 1800 rpm

UD-14A 4-cyl Diesel
4¾ x 6½; 461 cu. in. displ.; Eng. Max. hp—105 @ 1800 rpm; Power Unit Int. load hp—76 @ 1400 rpm

UD-350 4-cyl Diesel
4½ x 5½; 350 cu. in. displ.; Eng. Max. hp—92 @ 2000 rpm; Power Unit Int. load hp—75 @ 1800 rpm

UD-281 4-cyl Diesel
4⅛ x 5¼; 281 cu. in. displ.; Eng. Max. hp—68 @ 1800 rpm; Power Unit Int. load hp—60 @ 1800 rpm

U-308 6-cyl Carbureted 3 13/16 x 4½; 308 cu. in. displ.; Basic Eng. Max. hp—Gaso.—154 @ 3600 rpm; Power Unit Net hp: Gaso.—87.5 @ 2400 rpm; LPG—91.2 @ 2400 rpm

U-264-6 6-cyl Carbureted 3 11/16 x 4⅛; 264 cu. in. displ.; Basic Eng. Max. hp — Gaso. 153 @ 3700 rpm; Power Unit Net hp: Gaso. — 78 @ 2400 rpm; LPG—81 @ 2400 rpm

U-220 6-cyl Carbureted 3 5/16 x 3 11/16; 220 cu. in. displ.; Basic Eng. Max. hp: Gaso. — 112 @ 3700 rpm; Power Unit Net hp: Gaso.—68 @ 2400 rpm; LPG—68 @ 2400 rpm

U-281 4-cyl Carbureted
4⅛ x 5¼; 281 cu. in. displ.; Power Unit Net hp: Gaso. — 67.5 @ 1800 rpm; LPG—73 @ 1800 rpm

U-175 4-cyl Carbureted
3⅝ x 4¼; 175 cu. in. displ.; Power Unit Net hp: Gaso. — 50 @ 2000 rpm; LPG—51.5 @ 2000 rpm

U-123 4-cyl Carbureted
3⅛ x 4; 123 cu. in. displ.; Power Unit Net hp: Gaso.—33 @ 2000 rpm; LPG—27.5 @ 2000 rpm

UC-60 4-cyl Carbureted
2⅝ x 2¾; 60 cu. in. displ.; Power Unit Net hp: Gaso.—16.5 @ 2500 rpm; Nat. gas —13.5 @ 2500 rpm

Here you see the complete expanded 20-model line of International power—heavy-duty engines and power units that continue to justify the judgment of men who have specified International for more than 50 years.

Choose any of the 13 carbureted industrial engines, from 16 to 257 hp, or seven diesels, from 60 to 265 intermittent load hp, with full confidence. You'll always get an engine that delivers a full measure of dependable, economical power. And every engine is backed by the finest parts and service support in the world.

For full details on engines of interest to you, call in THE MAN FROM INTERNATIONAL. You'll find him as helpful as the power he sells will be profitable to your customers. Through him you can get assistance with all installation problems, including pilot model engines, and very special delivery service when you need it. Just call his headquarters in Melrose Park, Illinois—Fillmore 3-1800.

INTERNATIONAL® CONSTRUCTION EQUIPMENT

International Harvester Co., 180 N. Michigan Avenue, Chicago 1, Illinois

A COMPLETE POWER PACKAGE: Crawler and Wheel Tractors . . . Self-Propelled Scrapers . . Crawler and Rubber-Tired Loaders . . . Off-Highway Haulers . . . Diesel and Carbureted Engines . . . Motor Trucks . . . Farm Tractors and Equipment.



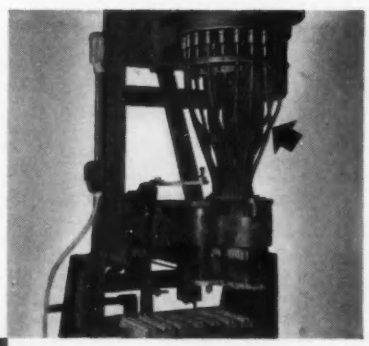
S.S.White

Flexible Shafts Step Up Design Efficiency

The manufacturer of this multiple spindle drill press finds that S.S. WHITE FLEXIBLE SHAFTS allow a wide range of positions for different drilling jobs.

This is only one example of the versatility . . . efficiency . . . and freedom S.S. WHITE FLEXIBLE SHAFTS are bringing to hundreds of industrial designs. The restrictions imposed by rigid shafting are eliminated. With flexible shafts you position power sources . . . driven members . . . controlled parts to better advantage. By simplifying methods of connection and adapting, costs can be reduced. Assembly is cheaper . . . alignment problems are eliminated . . . and product efficiency is often greatly improved!

Consider your own product. Chances are, S.S. WHITE FLEXIBLE SHAFTS are the simple, economical answer to your power drive and control problems. S.S. WHITE FLEXIBLE SHAFTS are noted for quality, performance and dependability. For more information and expert assistance in selecting and applying an S.S. WHITE flexible shaft to your product, just write to



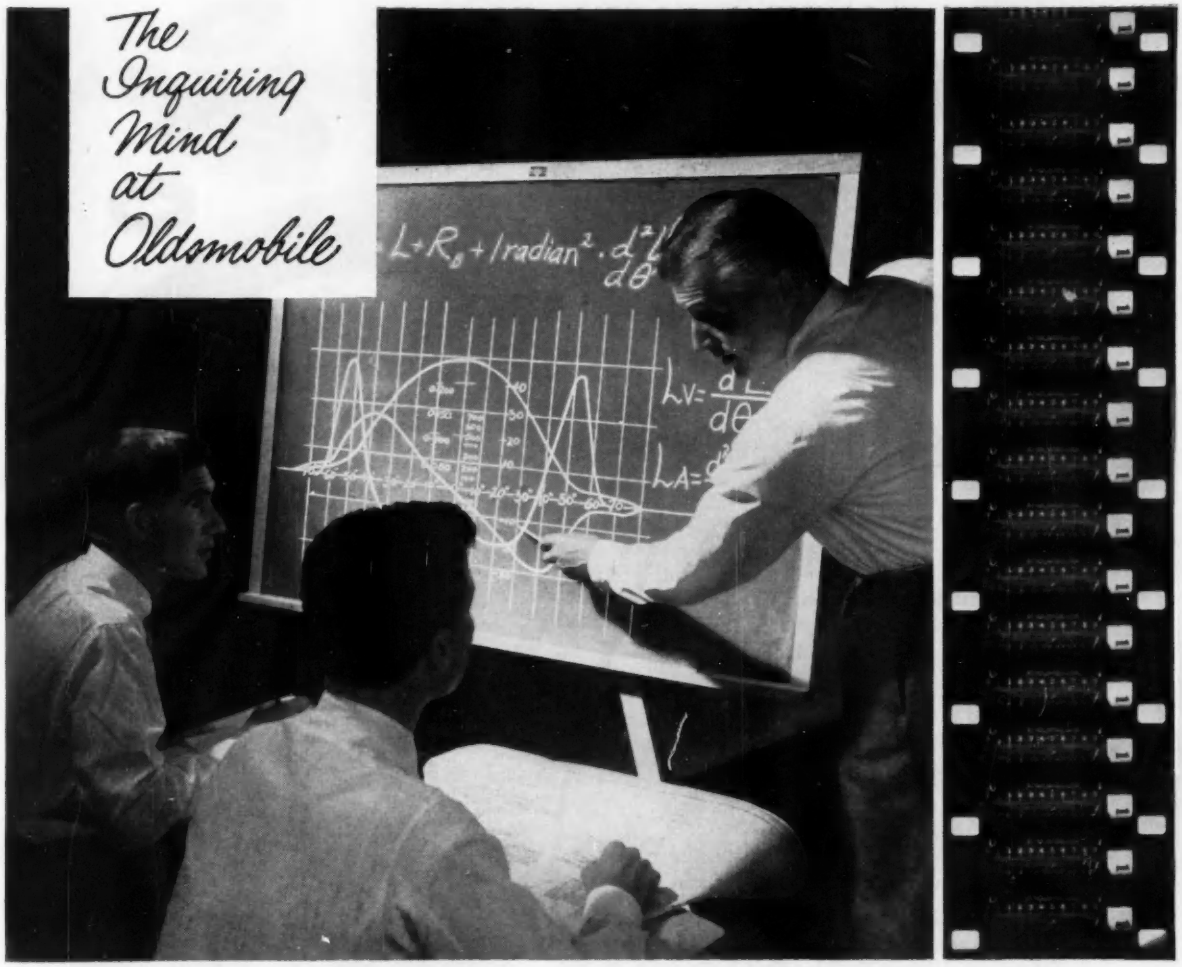
S.S.White

FIRST NAME IN FLEXIBLE SHAFTS



USEFUL DATA on how to select and apply flexible shafts! Write for Bulletin 5601.

S. S. White Industrial Division, Dept. J, 10 East 40th St., New York 16, N. Y. Western Office: 1839 West Pico Blvd., Los Angeles 6, Calif.



no.1 OF A SERIES

FORMULA FOR A NEW BABY OF OURS

High speed photography helps Oldsmobile engineers translate the theory of camshaft design into practical reality.

Developing the "brains" of an engine—its camshaft—demands engineering skill of a high order, both in theory *and* practice. Advanced techniques of precision measurement guide Oldsmobile engineers in creating a profile design of optimum efficiency.

To determine exactly what happens in a valve train system, movies are taken at speeds up to 15,000 frames per second. The valve train under study is assembled in an engine block and driven by an electric dynamometer at precisely controlled speeds. A vernier scale, silver soldered to the valve spring retainer, is photographed as it moves with the valve's opening and closing.

Essentially, these photographs act as an analog computer. Analysis gives a plot of the actual "lift curve" of the camshaft—the exact linear movement of the valve at each degree of camshaft rotation. It tells at what points the valve opens and closes and also whether the valve lifter is following the cam as it should. This curve, compared to the theoretical lift curve is a definite point for refining to begin—to make sure that design theory will be production practice. With this exact and rapid technique of analysis, as many as 50 experimental camshafts may be tested before a final design is fixed.

The Inquiring Mind at Oldsmobile is never at rest in its attempt to build the best engineered car in the industry. Test drive the '58 Oldsmobile and you'll find it's the finest product in our 60-year history.

OLDSMOBILE DIVISION, GENERAL MOTORS CORP.

OLDSMOBILE

Pioneer in Progressive Engineering ...Famous for Quality Manufacturing

One's right... for you



You can be certain that the oil seal International Packings Corporation recommends is the right one for *your* particular application.

IPC designs and manufactures a wide range and variety of oil seals and each one, large or small, is backed up by the "custom approach" to sealing problems.

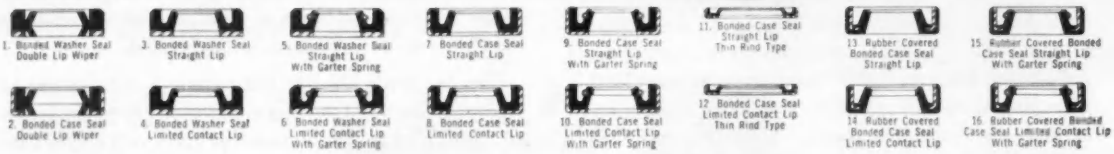
The superior performance of IPC oil seals in so many applications is a result of specialized engineering, custom compounding, precise manufacture and rigid inspections.

Let IPC assist you at the "planning stage" to assure you of outstanding quality and service . . . your IPC representative will be pleased to offer further information. Call him today.

...and IPC has it!

IPC

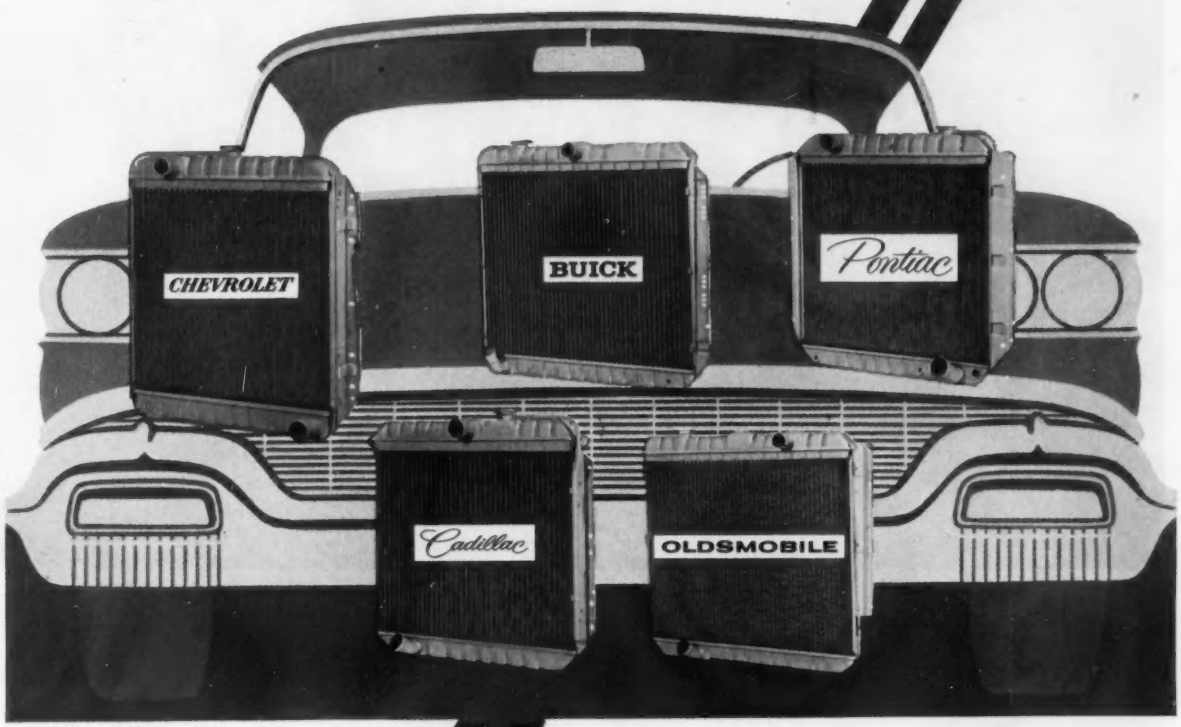
BONDED BY IPC



INTERNATIONAL PACKINGS CORPORATION

Bristol, New Hampshire

HARRISON'S OUT IN FRONT!



Cools GM's Famous Five!

GM
FORWARD FROM FIFTY

Harrison Radiators go hand-in-hand with today's high-compression performance. Harrison rigidly controls engine temperatures on Cadillac, Buick, Oldsmobile, Pontiac and Chevrolet to assure the most dependable and economical operation. These highly efficient tube-and-center type radiators are backed by over 47 years' experience in making top-quality temperature-control products. And Harrison's extensive research facilities are constantly at work to bring still more cooling advances to the industry. That's why you'll find Harrison heat-control equipment specified by the world's leading manufacturers of cars and trucks. If you have a cooling problem, look to Harrison for the answer.

TEMPERATURES MADE TO ORDER

HARRISON

HARRISON RADIATOR DIVISION • GENERAL MOTORS CORPORATION • LOCKPORT, NEW YORK



You can't BUY it until we TRY it

Few engineers have had the pleasure of seeing a new design spring into production without bugs. Many have been wounded by bugs that survived exhaustive lab tests, and emerged in production quantities on the road. American Brakeblok's on-the-road fleet testing prevents this painful experience.

To insure complete design confirmation, pilot production samples are subjected to field service conditions in cars and trucks completely instrumented to furnish comprehensive test reports. In addition, American Brakeblok's nationwide field service engineering is available to assist in your own evaluations.

For a complete picture of American Brakeblok service, send for the 20-page brochure, "Taming Dynamics with Engineered Friction." Good reading.

Complete Test Data Confirms New Designs

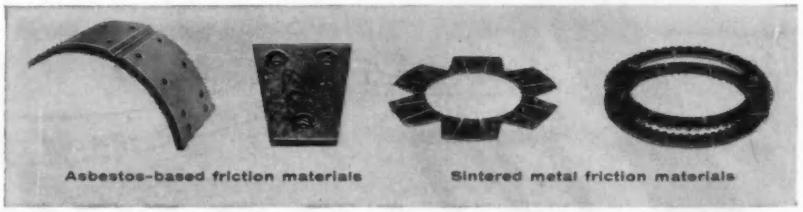


Sample data pages prepared for customers from tests



Drums and linings inspected after each test run

American Brakeblok
REG. U. S. PAT. OFF.
FRICTION MATERIALS

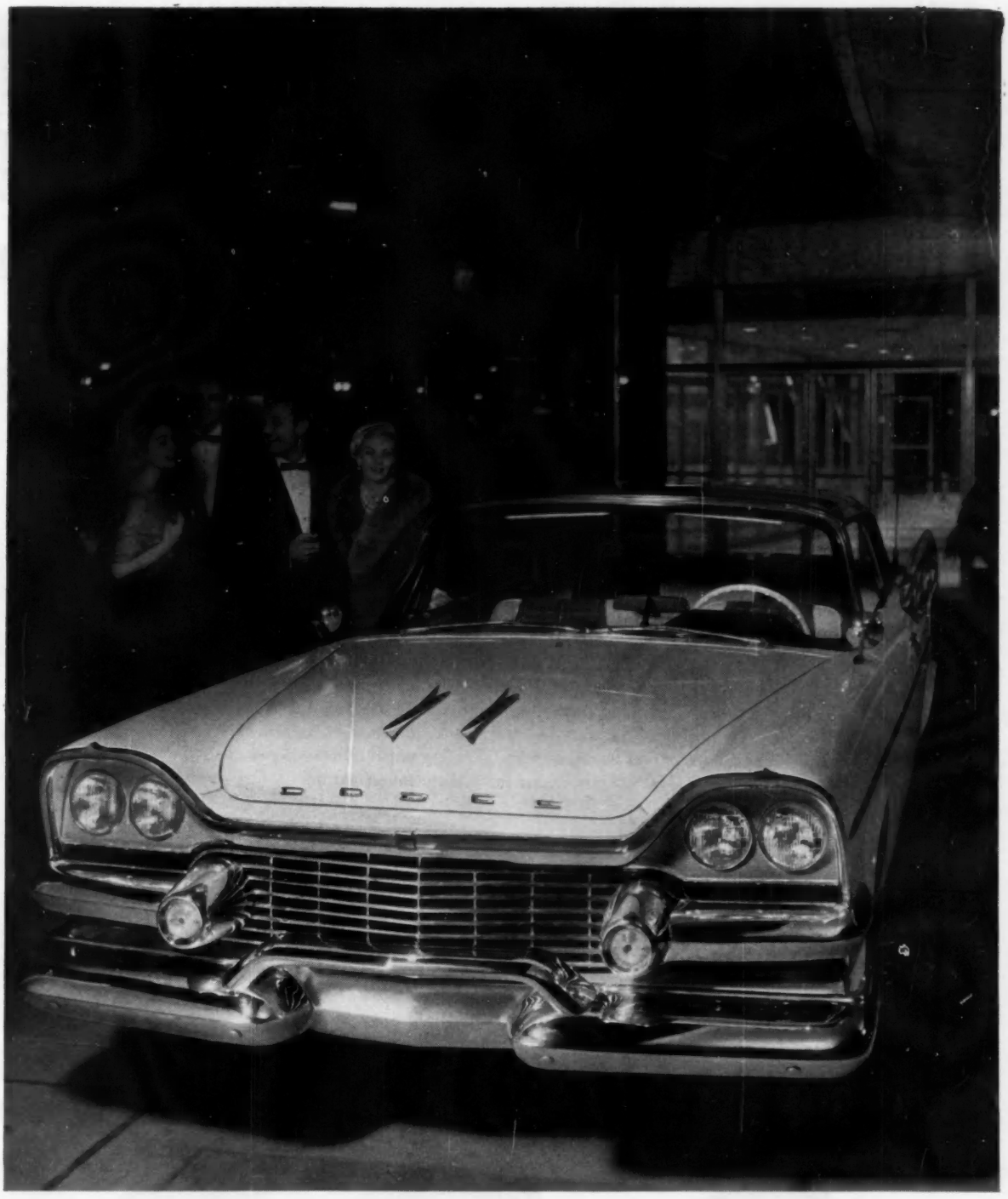


Asbestos-based friction materials

Sintered metal friction materials

American Brake Shoe Company

AMERICAN BRAKEBLOK DIVISION
DETROIT 9, MICHIGAN



A lot of the new cars look low (some almost as low as the Swept-Wing 58), but somehow they look a bit strange. That's because they've been "worked over" from the top down —at the expense of windshield area and interior room. Dodge doesn't have to make these sacrifices because it was designed low from the ground up. There are other important differences also. Suspension systems, for example. Dodge Torsion-Aire stops sway and "lean" on turns, prevents nose dive on sudden stops. It actually beats riding on air—and it's *standard equipment*, not an expensive option. Then there's push-button driving which most cars still don't have. Total-Contact Brakes for surer, safer stops. Bigger, higher-compression engines. "Check out" a Swept-Wing 58 at your Dodge dealer's. To drive it is a thrill, to own it is a new adventure.

SWEPT·WING 58 *by* DODGE

ANOTHER IDEA-PROCESS FROM A.O. SMITH...

Putting all the metal to work with



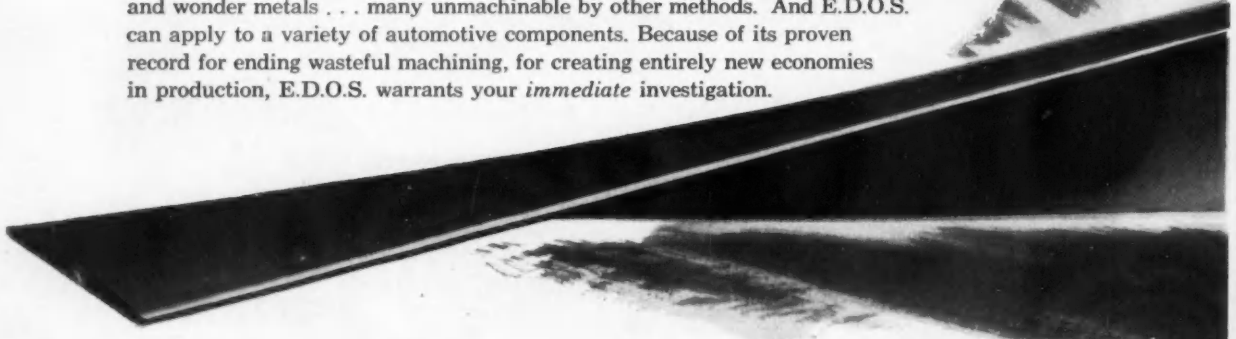
New "total use of metal" process from the auto industry's No. 1 frame supplier

Since 1902 A. O. Smith has mass produced nearly 55 million chassis frames . . . for virtually every make of American car. Our talent — creative mass production, unique ability to keep pace with your progress.

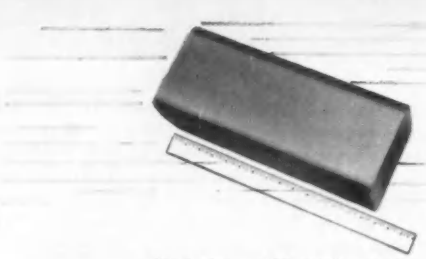
This steam turbine blade is a current example of A. O. Smith's production creativity. It was formed by our new E.D.O.S. process — which has *already* brought dramatic savings (as high as 70% compared to conventional methods) in metal *and* machining time to the aircraft and other metal fabricating industries.

Developed by A. O. Smith research, E.D.O.S. means engineered designs for optimum structures. Specifically, it consists of precision forging, contour rolling, flash and fusion welding . . . to put all of the metal to work.

It is possible for you to make these remarkable savings with steel, hard alloys and wonder metals . . . many unmachinable by other methods. And E.D.O.S. can apply to a variety of automotive components. Because of its proven record for ending wasteful machining, for creating entirely new economies in production, E.D.O.S. warrants your *immediate* investigation.



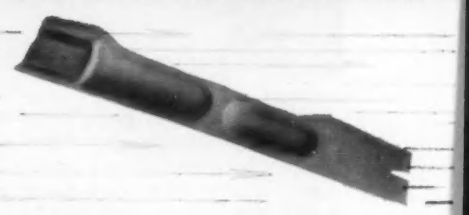
E.D.O.S., Engineered designs for optimum structures...



Original type 403 stainless steel billet before processing.



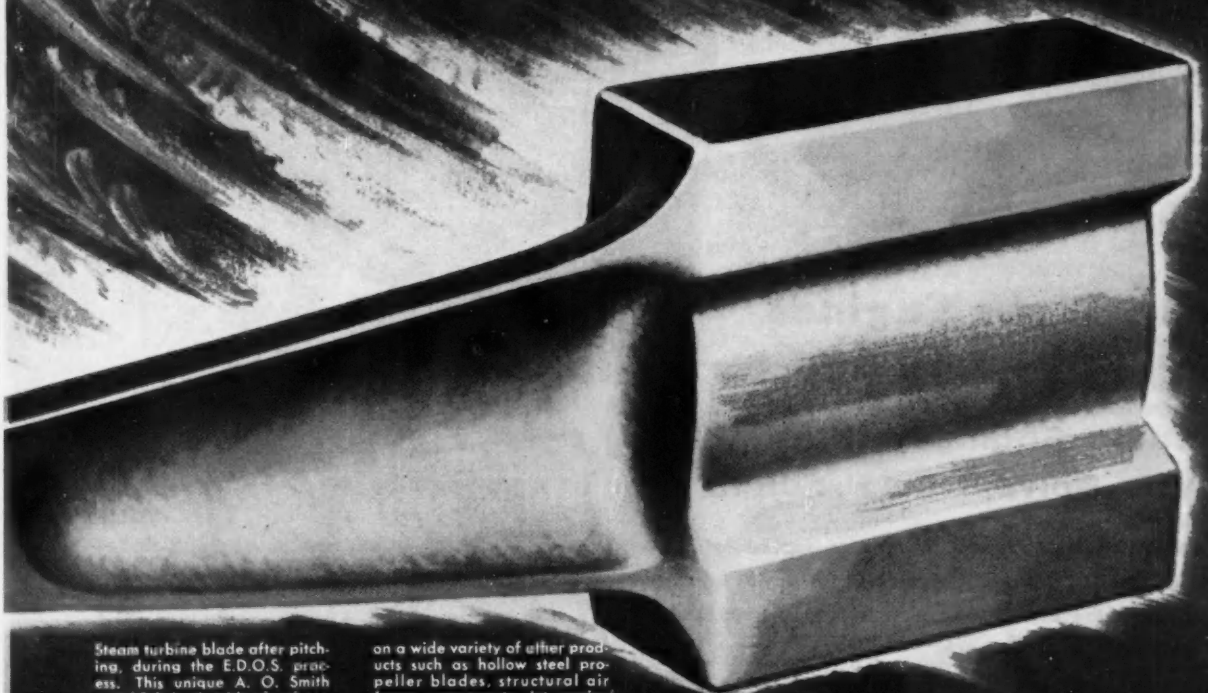
Fillout after initial precision forging operation has been completed.



Forged piece is successively rolled out to blade's full length.

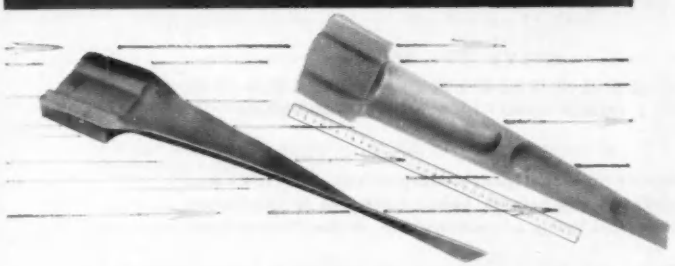
. . . partner in your progress through creative mass production

E.D.O.S.*



Steam turbine blade after pitching, during the E.D.O.S. process. This unique A. O. Smith metal fabricating idea has been creatively applied from customer prints to production run . . . on a wide variety of other products such as hollow steel propeller blades, structural air frame components, jet engine spacer rings and numerous other industrial parts and assemblies.

here's how it works...



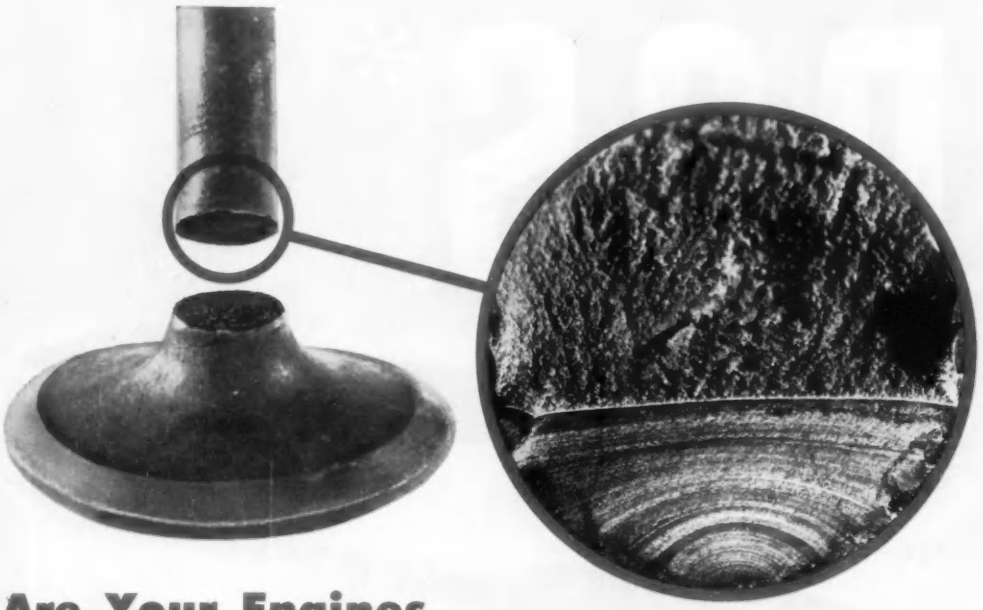
Blade pitch is accurately obtained through hydraulic press operation.

Finished blades, over 100 per turbine, are delivered to the customer, ready to be installed after simple machining on the root.

*Write for Bulletin 1-1 E.A. describing the E.D.O.S. process . . . just one of the many ideas produced from A. O. Smith, partner in your progress through creative mass production.

Through research A.O. Smith *. . . a better way*

A.O.Smith
CORPORATION
AUTOMOTIVE DIVISION
MILWAUKEE 1, WISCONSIN
A. O. Smith International S.A., Milwaukee 1, Wis., U. S. A.

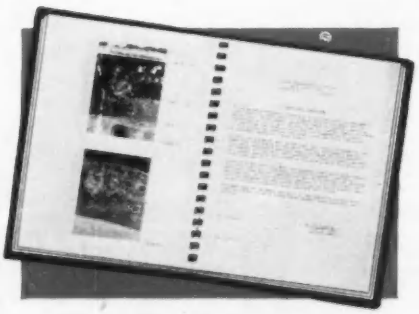


Are Your Engines Plagued by Failures Like This?

Eaton Engineers Can Help You Solve This Problem

The photographs above illustrate a typical fatigue-type failure caused by overstressing, in which fracture starts at the surface and, with repeated high stress, progresses to final break.

If you are an engine manufacturer and are having valve gear problems, Eaton engineers will be glad to consult with you and recommend procedures to help solve them. Or if you are designing new engines, perhaps our past valve experience can be valuable to you. Write, wire, or phone — there's no obligation.



Eaton Technical Reports are Available to Manufacturers

Eaton valve engineers will be glad to make a thorough study for you and furnish a complete technical report.

EATON *VALVE DIVISION*
MANUFACTURING COMPANY
9771 FRENCH ROAD • DETROIT 13, MICHIGAN

PRODUCTS: Engine Valves • Tappets • Hydraulic Valve Lifters • Valve Seat Inserts • Jet Engine Parts • Hydraulic Pumps Motor Truck Axles • Permanent Mold Gray Iron Castings • Forgings • Heater-Defroster Units Automotive Air Conditioners Fastening Devices • Cold Drawn Steel • Stampings • Gears • Leaf and Coil Springs • Dynamatic Drives, Brakes, Dynamometers

SAE Journal

Publication Office: Business Press, Inc.
10 McGovern Ave., Lancaster, Pa.

Published by

Society of Automotive Engineers, Inc.

W. Paul Eddy
President

John A. C. Warner
Secretary and Gen. Manager

B. B. Bachman
Treasurer

NEW YORK—Headquarters

485 Lexington Ave.
New York 17, N.Y.
Tel: OXford 7-3340
Teletype: NY1 228

BRANCH OFFICES

DETROIT

G. J. Gaudaen, Manager
635 New Center Bldg.
Detroit 2, Mich.
Tel: TRinity 1-1772

WEST COAST

E. W. Rentz, Jr., Manager
714 West Olympic Blvd.
Los Angeles 15, Calif.
Tel: RIchmond 9-6559

ADVERTISING OFFICES

E. D. Boyer, Advertising Sales Manager
485 Lexington Ave., New York 17, N. Y.
Tel: OXford 7-3340 Teletype: NY1 228

DETROIT

A. J. Underwood, District Manager
3-210 General Motors Bldg.
Detroit 2, Mich.
Tel: TRinity 2-0606
Teletype: DE 826

CHICAGO

W. W. Milne, District Manager
7530 Sheridan Rd.
Chicago 26, Ill.
Tel: AMbassador 2-7091
Teletype: CG 2244

CLEVELAND

Hamilton E. Finney, District Manager
3537 Lee Road, Shaker Heights
Cleveland 20, Ohio
LOngacre 1-5480

PACIFIC COAST

Chris Dunkle & Associates, Sales Representatives

Los Angeles:
740 S. Western Ave.
Los Angeles 5, Calif.
Tel: DUnkirk 7-6149

San Francisco:
Jack Kimball, Manager
420 Market St.
San Francisco 11, Calif.
Tel: DOuglas 2-9183

The Society is not responsible for statements or opinions advanced in papers or discussions at its meetings or in articles in the Journal.

All technical articles appearing in SAE Journal are indexed by Engineering Index, Inc.

SAE Journal is available on microfilm from University Microfilms, Ann Arbor, Mich.

A complete index of all technical articles appearing in SAE Journal from January through December will appear in the December issue.

Copyright 1957, Society of Automotive Engineers, Inc.

Please address all editorial, advertising, and Special Publications mail to 485 Lexington Ave., New York 17, N. Y.

For the Sake of Argument

The "SA Factor"

By Norman G. Shidle

Industrial psychologists are beginning to rate what they call a man's "SA factor," an important ingredient of his usefulness to an engineering department.

This "SA factor"—as we understand it from listening around the edges of a recent discussion—rates the particular combination of Stability and Ability with which we each are blessed. It's the combination—and the balance—apparently, which floats one man toward the top of a group; leaves another a comparative outsider.

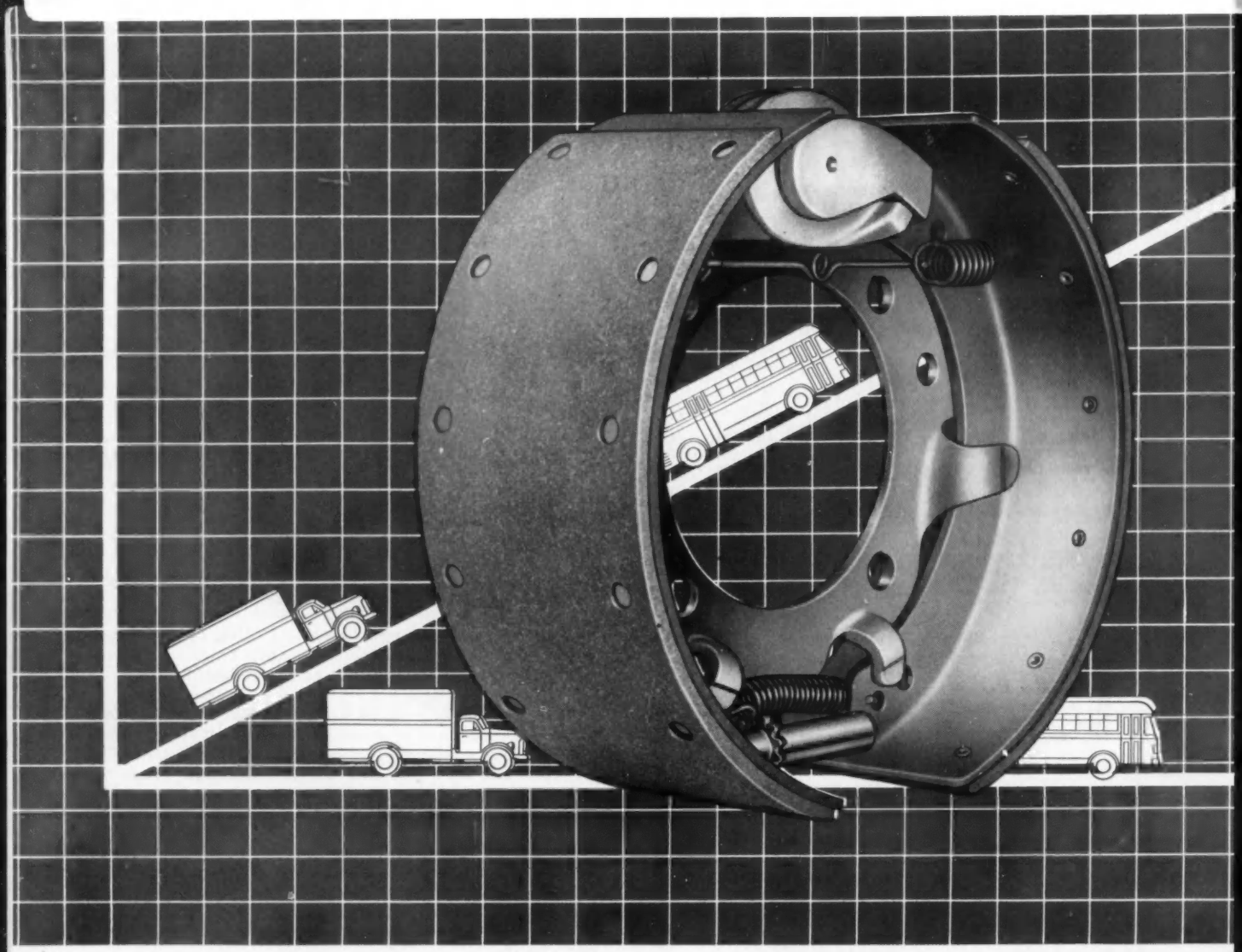
Dr. David Soper, for instance, indicates the stably unable are dependable but not very productive; and the ably unstable give promise of achievement but are not reliable. It is the combination of stability with ability which makes a creative and successful personality.

The talent whose application is predictable, in other words, can be used by an organization to its fullest. When performance-relation to the group is unpredictable, the talent finds only partial application of its full potentials.

But the reverse is equally true. A 100% stable application of no talent equals zero, no matter how the equation is written.

An overabundance of stability can't compensate for serious lack of ability . . . any more than superb ability can compensate for serious lack of stability, as far as work in an organization is concerned.

But as Dr. Ralph W. Sockman says "A person's IQ can be stepped up by the arousing of interest. In the same manner, a person's stability-ability quotient can be developed."



BENDIX DUO-DUTY AUXILIARY BRAKE

Power to hold on grades . . . Power to stop at road speeds

The Bendix* Duo-Duty auxiliary brake serves the double purpose of a positive parking brake and an emergency road-speed brake.

FOR PARKING, the Duo-Duty brake has ample torque capacity to keep the braked wheels from rolling on any hill or ramp, regardless of how steep.

FOR EMERGENCIES, it has the torque and thermal capacity to serve as a dependable stand-by brake at road speeds should the main braking system, for any reason, fail to work.

Minimum physical pull at the hand lever, less weight, fewer parts, mechanically simple.

A heavy-duty drive shaft brake that is rugged and right . . . built and backed by Bendix.

*REG. U.S. PAT. OFF.

BRAKES • POWER STEERING • POWER BRAKING • CONSTANT VELOCITY UNIVERSAL JOINTS • HYDRAULIC REMOTE CONTROLS

Bendix PRODUCTS DIVISION South Bend, IND.

Export Sales and Service: Bendix International Division, 205 East 42nd Street, New York 17, N. Y.

Bendix AVIATION CORPORATION

Trends in 1958 CAR DESIGN

Walter G. Patton

Staff Representative, SAE Passenger-Car Activity Committee (and Engineering Editor, SAE Journal)

Written at the request of the SAE Passenger-Car Activity Committee, the members of which cooperated in supplying material for this article.

Contents of Article page

Engines and Power Trains 28
- Fuel Injection
- Exhaust Systems
- Cooling
- Transmissions and Drive Controls
- Drive Lines and Rear Axles

Chassis 64
- Air Suspensions
- Rear Suspensions
- Frames
- Tires, Rims, and Wheels
- Brakes
- Steering

Lighting and Accessories 66F
- Instrument Panels
- Heating and Ventilating

Bodies and Styling 67

THE familiar criticism of the U. S. passenger-car industry that all cars look alike is less applicable in 1958 than at any time during the past decade.

There are, at present, at least three different schools of styling. Chrysler Corp. stylists favor large, prominent fins, which make their cars easily recognizable on the highways. Other car manufacturers have fins that are less prominent—but easily recognizable. Several of the 1958 cars rely on other styling details—sculptured metal, for example,—to achieve ready recognition by the public.

Sum it up this way: styling trends for the future are probably less predictable this year than in any recent year.

Individuality in engineering is even more pronounced in the 1958 cars. The new models contain a surprisingly large number of new engines. Ford and Chrysler each have a series of new powerplants. Nearly all car manufacturers have

continued on page 28

Typical 1958 Passenger Cars



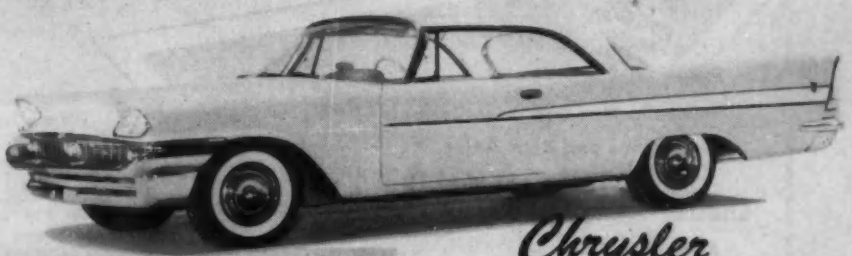
Buick



Cadillac



Chevrolet



Chrysler



De Soto



Edsel



Dodge


Ford
Lincoln
Mercury
Plymouth
Pontiac
Oldsmobile
Rambler
Studebaker

continued from page 25

made significant refinements in their 1957 engines.

Differences in transmissions and suspension systems are, if anything, greater than ever.

Here are the top engineering news items for 1958:

1. Adoption of dual headlights by virtually the entire industry.
2. Introduction of air suspension as optional equipment by all car producers except Chrysler and Studebaker-Packard.
3. Lowering of cars by all producers in a position to do so.
4. Lincoln became the first producer to join American Motors in the use of unitized body-and-frame construction.

During the past 19 years, American-built passenger cars have been lowered 19 in. Last year, some cars were lowered as much as 5 in. Maximum reduction this year is 4.5 in.

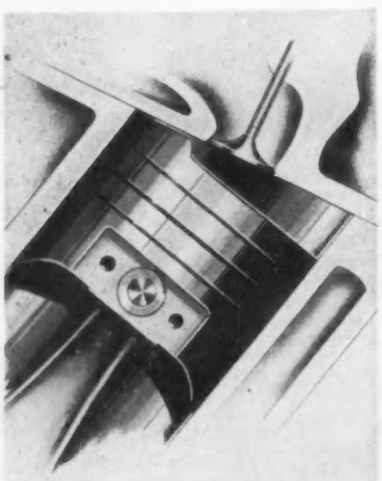
Reducing the ground-to-roof height of a passenger car affects many of its major components. For this reason estimated new tooling costs again aggregated over a billion dollars. Engineering man-hours required for these programs hit astronomical figures.

Engines . . .

. . . have higher horsepower, but there's more emphasis this year on improved fuel economy, better cooling, weight savings, and redesigned combustion chambers.

Table 1—Horsepower Data (Compiled by GM Research Staff in 1956)

	Average Hp per Car
1930	75
1940	125
1955	180
1980	250 (est.)



WEDGE-SHAPED combustion chamber and step-top piston are used in 1958 Mercury engine.

AGREEMENT by the automobile industry that it will not emphasize speed in advertising its 1958 products came too late to have much effect on the 1958 engines. As shown in Table 1, horsepower is still going up. Nevertheless, the 1958 engines reflect the most serious attempts made in recent years to capitalize on the economy potential of large engines.

In addition to changes in camshaft design, valving, compression, and axle ratios, two interesting forward moves have been made (by Chrysler and Oldsmobile) to provide improved economy. These will be described later.

Ford Motor Co. has introduced two series of new engines. Engines in the range 383–430 cu in., built at the Ford-Lima plant are available on Lincoln, Edsel, and Mercury. Smaller engines are being built at the Ford-Cleveland engine plant.

Mercury's Super Marauder 430 cu in. engine has three 2-barrel carburetors; other Marauder engines have 4-barrel carburetors. Two other Marauder engines have 383 cu in. displacement. Compression ratio of all engines is 10.5/1.

These new engines have a new block, stronger crankshaft, heavier connecting rods, and improved lubrication and cooling systems. Combustion chambers have been redesigned for closer tolerance and better control of combustion ratio. The combustion chamber is wedge-shaped. New step-top pistons increase turbulence of the air-fuel mixture.

Axle ratio is 2.69/1 with the 383 cu in. engine and 2.91 with the 430 cu in. engine. Local hot spots, it is claimed, have been eliminated by alternating the intake and exhaust passages so that no two exhaust valves are adjacent to each other.

The integral power-steering pump is mounted directly off the end of the crankshaft, replacing a belt-driven pump.

Better cooling is achieved by using three distinct stages and three separate thermostats.

Wedge-type combustion chambers on the 1958 Ford cylinder heads are machined to give greater accuracy and discourage carbon buildup. Spark plugs are angled for optimum flame propagation. Cast crankshafts have been reinforced at vital areas where stresses are high. There has been considerable increase in journal overlap. The 1958 valve train is simpler, lighter, and more accessible. The new Ford engines have 332 and 352 cu. in. displacement.

Ford also offers a 292 cu in. V-8 and a 6-cyl engine. Locating the

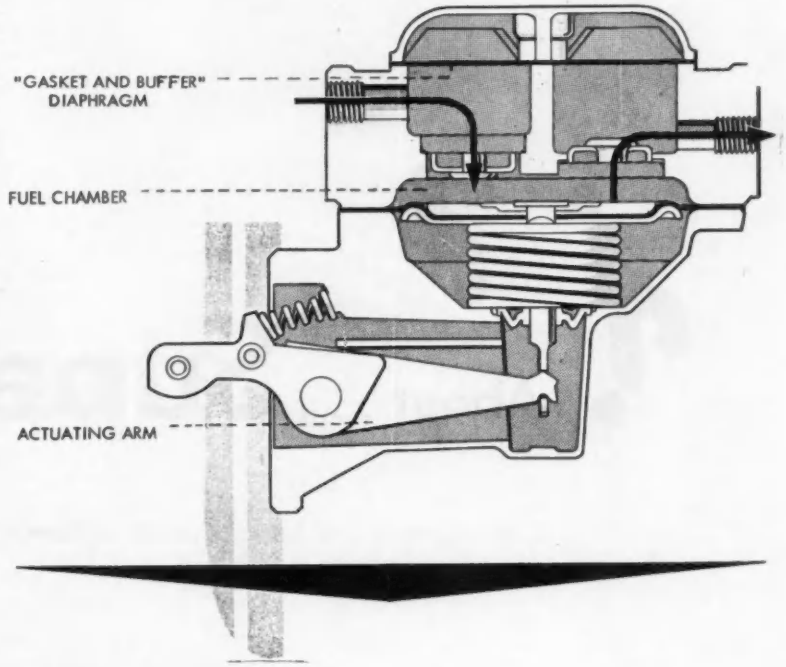
fuel pump inside the oil pan at the lower left front of the engine helps to resist vapor lock and reduces engine noise.

In designing its new 350 and 361 cu in. engines, Chrysler has reduced weight as much as 70 lb, compared with other powerplants of similar displacement, it is reported.

Tapered combustion chambers and in-line overhead valves with hydraulic lifters are used. Deep-skirt blocks provide additional rigidity. A lighter cylinder head was made possible by exceptionally short and direct exhaust passages. A new series-flow cooling system permits better cooling of exhaust-valve seats, combustion chambers, and other critical areas. The new engines are also more accessible for servicing.

Chrysler's Econo-Choke system is designed particularly for start-and-stop city driving. Newly designed carburetors closely regulate the fuel-air mixture during warmup and noticeably reduce gasoline consumption, according to Chrysler engineers. Chrysler tests show 3 mpg more of gasoline in typical housewife-to-the-grocery trips of less than 5 miles.

The Econo-Choke has a triple-stage vacuum piston designed to match the choke position more accurately to engine needs during warmup. The redesigned piston, it is claimed, prevents overly rich mixtures during part-throttle operation.



MERCURY FUEL PUMP HAS:

- Single-unit gasket-and-buffer diaphragm to minimize rhythmical pulsations inherent in mechanical fuel pumps.
- Higher actuating arm ratio to assure better fuel-handling characteristics.
- Fuel chamber with internal contours smoothed out and counterbores eliminated, to provide more complete evacuation of fuel from chamber to discharge side of pump.

Included in the engine refinements Buick made in its 1958 models are the substitution of an aluminum water pump cover for a cast-iron part, resulting in a 3.0-lb weight saving. The change is designed to improve hot-weather operation.

Improvements in carburetors to resist vapor lock and flooding have also been made.

An important change made by Buick this year is adoption of a new air cleaner and silencer assembly built by AC Spark-Plug Division. Higher dust filtering efficiency, easier servicing, low restriction, and a 35% weight saving are claimed for the new air cleaner. Other car companies are also using this new air cleaner.

A dry cellulose fiber element replaces the conventional oil bath element. The new filter element is reported to have a filtering efficiency greater than 98%.

For 1958 Pontiac is offering four basic engines and two special engines. Fuel injection is being continued.

Pontiac's Tempest 395 V-8 engine has been increased from 347 to 370 cu in. Compression ratio is a new high of 10.5/1 on fuel-injection engines and engines having three 2-barrel carburetors.

Larger diameter pistons, new camshaft timing, a new exhaust manifold, and cylinder-head exhaust ports that are 17% larger than last year are included in the new Pontiac powerplants. The block has been strengthened and a full fan shroud provides optimum engine cooling.

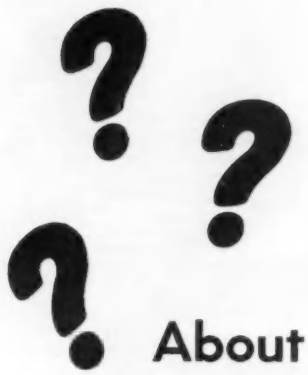
Changes in Pontiac fuel injection include cast-aluminum intake manifold, wire screens in the fuel nozzles ahead of the metering orifice, a single line signal system, and improved hot starting and idling.

Oldsmobile 88 is offering a new 2-barrel Econ-o-Way carburetor and other refinements that offer the car owner fuel savings up to 20%. Oldsmobile engineers say improved economy is gained "by reducing the performance factor at the top of the horsepower curve and diverting this seldom-used high-speed performance to low- and medium-speed fuel economy."

Oldsmobile is offering three different Rocket engines this year. Compression ratio is 10/1 and displacement is 371 cu in. for all three engines. Improvements include a new camshaft contour, better breathing, a new filter for the quadri-jet carburetor, more generator capacity.

Cadillac has increased compression ratio from 10/1 to 10.25/1. Combustion chamber and carburetor are redesigned. Larger exhaust valves and a more efficient air cleaner result in better engine

CONTINUED ON PAGE 59



About . . . Supersonic

. . . Here's your chance to check your

Excerpts from paper by

F. Rodwell Banks, director

Bristol Aeroplane Co., Ltd.

THE next big step in civil aviation may be the long-range supersonic airliner, but I doubt if such an animal can be in service much before 1975.

I cannot convince myself that the "economics" of supersonic flight are practicable for any range or stage length less than 3000 miles, still air. But a greater range than this may be very difficult to achieve. (By supersonic, I mean in the region of Mach 1.7–2 . . . cruising, say, at 1.6.)

Some consider that a smaller step should be made to Mach 1.3. But the enormous increase in cost in advancing from Mach 0.86 to 1.3 would hardly appear to be justified. A larger step seems more worth while. At any speed beyond Mach 2, the increase in cost and complexity will be multiplied many times. Steel would have to be used as the structural material, and it has better fatigue life than the light alloys. But considerable refrigeration would be necessary for the passengers, crew, and equipment.

Three points stick out a mile when considering the large supersonic job, which could seemingly hazard its operating economics, particularly in comparing it with the near-sonic counterparts now building.

The first concerns aeroelasticity, the control or limiting of which may involve higher structure weight, and the second is the enormous weight of fuel to be carried—both tending seriously to limit payload. The third point has to do with lift/drag value, and here I am on more uncertain ground since I know little of these matters. But it appears that, while a lift/drag ratio of between 16–18/1 is achievable in the case of the large jet aircraft designed to operate at the practical limit of subsonic speed, about half this value is likely for one designed to fly at Mach 1.7.

Assuming, therefore, that it were feasible to achieve a lift/drag ratio of 8 with development; then with a basic or structure weight of 40% and an engine-continuous-cruising specific fuel consumption of 1, the payload for a long-range machine could be in the order of 10%. But it would involve much engine development to achieve such a specific fuel consumption, and any appreciable increase in the cruising fuel consumption above unity would react directly upon payload and range. Hence failure, even by a fractional amount, to achieve the calculated performance for a long-range nonstop (Atlantic) job could well result in a big splash some hundreds of miles from shore.

It can, therefore, be appreciated why some designers and constructors consider the first and more practicable step in the development of the supersonic airliner to be Mach 1.3, as it is then possible to achieve a somewhat better lift/drag value (of, say, 10) provided there is subsonic flow over the wing, that is, sweep back. Since, at this speed, the machine is near to the transonic band, it can avoid handling and other difficulties by flying subsonic when, for example, in the traffic holding pattern.

To avoid aeroelasticity problems and, therefore, to keep structural weight to the minimum, the extreme angle (paper dart) delta of very thin section might be an answer; but its take-off and landing speeds would be excessive, demanding some form of

Transports

guesses against the forecasts of a distinguished British engineer . . .

high lift, and drag, devices—or still longer runways!

I have been accused of undue pessimism in dating the supersonic transport for 1975. In a previous lecture given before the Royal Aeronautical Society in London, I was perhaps less pessimistic and volunteered 10 years and £50 million ($140 million) for two prototypes and the necessary jigging and tooling for production. But after further thought I would now raise these figures to 15–20 years and around £100 million ($280 million).

This is quite big money even in the United States and a company board of directors would have to think hard before backing such a venture. Even if the Government offered to defray the development costs, practically the whole of the technical resources of a firm would be tied up for some years. So, any company intending to go ahead on such a project should already have a good bread and butter line of aircraft in production, keeping its personnel and key labor force employed and available.

Some may consider that 15–20 years for the introduction of the supersonic machine to airline service is excessively long-term. But, although some sort of supersonic aircraft could be designed and built within this period it is doubtful if it would be attractive to the operator, who would be hard put to find the money to buy it and lucky if he could then operate it at a profit.

This is where an active military program of development could be invaluable, to provide through the supersonic bomber a firm, or firmer, stepping stone for similar progress in the civil field. But it is now a race between the (supersonic) bomber and the guided missile, which, if the latter wins, will inevitably put the development of the faster-than-sound civil aircraft strictly on its own much more limited resources and backing.

Both the economic and engineering outlooks for supersonic airliners are examined frankly in this article by a leading world authority. Facing the current switch to missiles, he details how and why he arrives at his conclusion that:

"It is now a race between the supersonic bomber and the guided missile, which, if the latter wins, will inevitably put the development of the faster-than-sound civil aircraft strictly on its own much more limited resources and backing."

In the significant paper from which this article was excerpted, Banks peers into the economic-engineering future of both British and American aircraft industries. Plans outlined by the British Minister of Defense, he says, "suggest a major shutdown on most future aircraft projects and leaves us with some 'V' bombers, one or two types of subsonic fighters, a supersonic fighter, and possibly 'one other'."

To Order Paper No. 197a . . .
. . . on which this article is based, turn to p. 5

New Combination Test Developed for Gear Oils

A NEW full-scale axle technique for testing multi-purpose gear lubricants has been developed that combines in a single test both high-speed and high-torque requirements. This test has given good correlation with field tests run by the Ornance Corps at Yuma, Ariz. in highly loaded vehicles. This new test procedure (CRC Designation L-37), which was developed at the request of Ordnance, is described in the recently released CRC report 308.

For some time Ordnance has realized the need for major changes in the military specification MIL-L-2105, for gear oil. This specification is based on the L-19 high-speed scoring test and the L-20 low-speed, high-torque test. Both of these tests are over 10 years old. During this time continually increasing horsepowers have meant that the axles of cars and trucks have been operating under increasingly severe speed and torque conditions. As a result, the L-19 and L-20 tests no longer represent operating conditions as severe as those met in the field.

The new L-37 test is, in effect, a replacement of the L-20 test. Work is still in progress on a more severe high-speed scoring test to replace the L-19 test. It is expected that this replacement will be released by CRC in the near future.

If the Army accepts both tests, it may issue a new military specification to replace MIL-L-2105. It is possible, however, that consideration may be given to an additional test procedure dealing with temperature stability.

Table 1—Test Conditions for New L-37 Gear Oil Test Compared with Those of Earlier L-20 Test

	L-20 Low-Speed, High-Torque Test	L-37 Combination High-Speed, Low-Torque and Low-Speed, High-Torque Test
Apparatus	Laboratory dynamometer	Laboratory dynamometer
Axle Type and Ratio	Dodge ¾-ton Army truck; 5.83/1	Dodge ¾-ton Army truck; 5.83/1
Transmission Type	None	Manual-shift, 4-speed
Gear Coating	None	Either uncoated or phosphate-coated gears, or both, may be used
Breakin Procedure	20 min at ring-gear speed: 62 rpm, load: 6000 in.-lb; temperature: 140 F	None
Test Procedure	30 hr continuous at steady load	100 min steady, continuous high speed (a) 24 hr continuous at steady load (b)
Ring-Gear Torque, in.-lb	32,300	(a) 9460 (b) 41,800
Ring-Gear Speed, rpm	62	(a) 440 (b) 80
Gear Oil Temperature, F	200–250 (controlled cycles)	(a) 300 max (uncontrolled steady) (b) 272–278 (controlled steady)

How L-37 Differs from L-20

Specifically, the new test technique is for determining the load-carrying, wear, and extreme-pressure characteristics of gear lubricants in axles under conditions of high-speed, low-torque operation, followed by low-speed, high-torque operation, using a single gear set. The combination technique differs from L-20 in that:

1. The L-20 test did not have high-speed running on the gears prior to the high-torque run.
2. The high-torque portion of the combination test is more severe than the L-20 test.

Table 1 shows how the operating conditions of the L-37 test differ from those of the L-20 test.

The work that resulted in the L-37 test technique was carried on by the Development of New Test Techniques Panel of the CLR-VLD Gear Lubricants Group. Leader of the panel is T. P. Sands.

CRC report 308, "Development of Test Techniques for Determining Load-Carrying, Wear, and Extreme-Pressure Characteristics of Gear Lubricants in Axles under Conditions of High-Speed, Low-Torque Operation, Followed by Low-Speed, High-Torque Operation," contains 22 pp., including appendices, with diagrams and photographs.

To Order CRC-308 . . .
. . . on which this article is based, turn to page 5.

Mating the P&W J57 Turbojet to the F-102 . . .



. . . wasn't easy. Here's how some of the engine installation problems were solved.

Based on paper by

R. J. Chillo,

Propulsion Design Group, Convair (San Diego), a division of General Dynamics Corp.

THE installation of the P&W J57 turbojet engine with afterburner on the F-102 interceptor has many interesting features. We will discuss here those pertaining to the following:

- Engine mounting system.
- Air intake.
- Engine shroud.

Engine Mounting System

The engine mounting system (Fig. 1) is simple and rugged, and designed so that airframe deflections will not rack the engine. The main mount, taking thrust and loads in all directions, is of the spherical bearing type and is located at the right side of the compressor inlet case. Fittings are titanium, except for the chrome-plated steel bearing and a steel installation clamp. The V clamp connects the joint between engine and fuselage parts that transmit thrust loads through a step in the fittings. Alignment before clamping is assured by a "wedding ring" slipped on prior to clamping. An adjustable link provides vertical adjustment. One of the first clamps, made of titanium, failed on installation because of poor grain structure and was immediately eliminated from this critical location. Fine surface finishes and graphite grease prevent galling between ball and housing, as was experienced on the prototype aircraft—the YF-102.

The mount at the left of the compressor inlet case is an adjustable link assembly between titanium fittings on the engine and fuselage. This link also provides adjustment for alignment of the accessory drive cross-shaft.

Two inclined adjustable linkage assemblies support the aft end of the engine. Link attachment fittings of A-286 stainless steel are bolted to engine support flanges with inconel X bolts. Nonadjustable links are Hi Tuff steel, metal sprayed with aluminum. Each end of the link has a spherical bearing to allow engine expansion and movement. The links are attached with Hi Tuff bolts to titanium fuselage-mounted adjustable beams and fittings. At first, the adjustment screw seized when baked-on dry film lubricant was used, but this problem was eliminated by the removal of the lubricant and use of graphite grease. Engine fittings originally were inconel X, but procurement difficulties caused a change to A-286 stainless steel.

Air Intake

The inlet duct is bifurcated (Fig. 2) because the aircraft nose houses electronic gear. Inlets are placed for minimum drag and best pressure recovery. The result is a long duct, with high losses

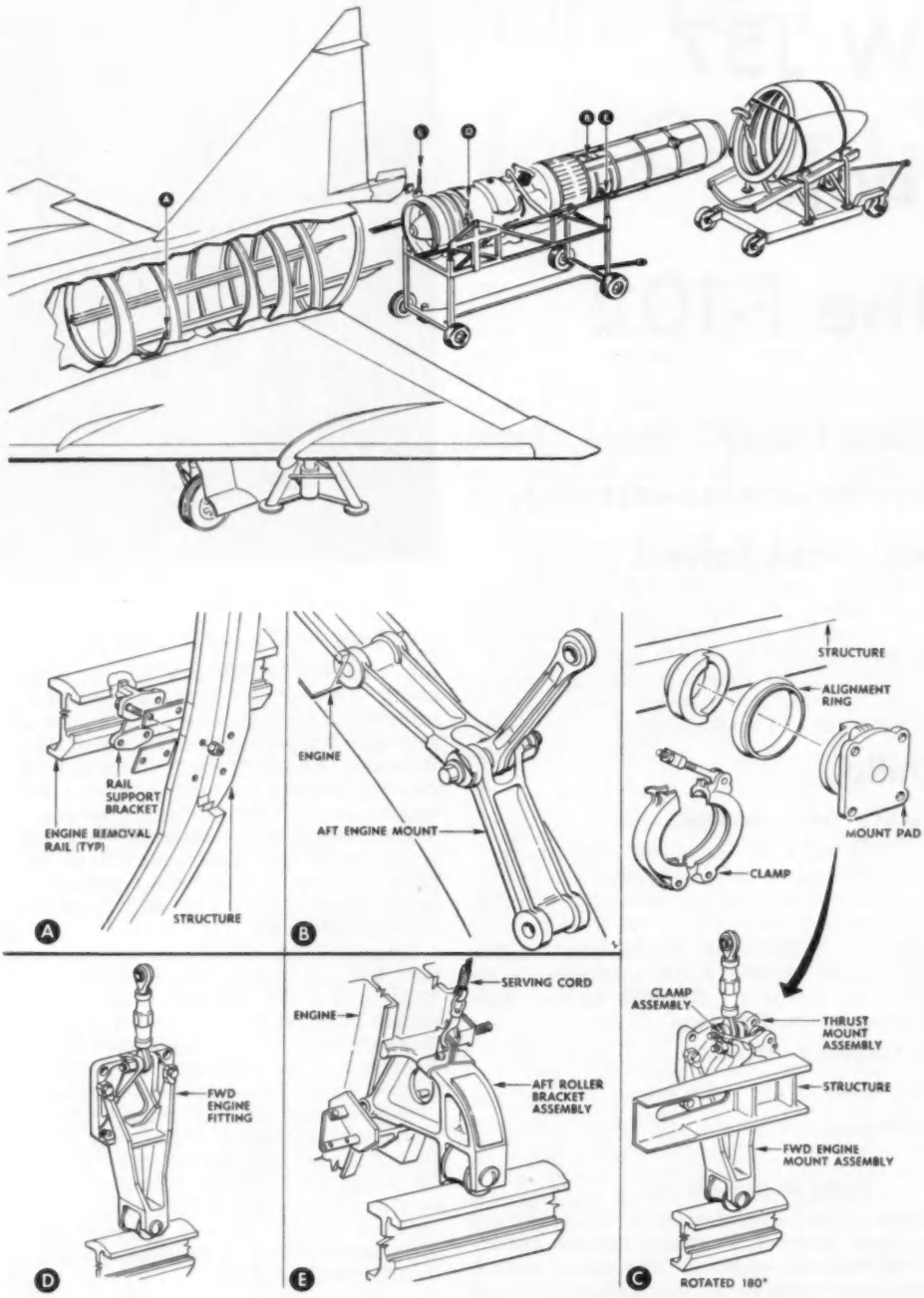


Fig. 1—Engine mounting system is simple and rugged, and designed so that airframe deflections will not rack engine.

possible unless adequate consideration is given to the problem. However, the long duct, with its gentle turns, constant section for several diameters ahead of the engine, and boundary layer extraction for cooling air, does provide good pressure recovery and distribution across the compressor inlet. The induction system interior is sprayed with lacquer as protection against corrosive products of armament firing. Fortunately, such firing does not cause compressor stall and has negligible effect on engine operation.

The inlets are kidney-shaped and of normal shock, cheek type. Most of the boundary layer is plowed off, except for a small central area used for air conditioning cooling. A ramp was added when duct inlet buzz was encountered during limit dive. Each inlet has an area of 330 sq in. and supplies all of the air for engine and compartment cooling.

From the inlets, the ducts expand rapidly in area to the "integral duct," so called because it is integral structurally with the fuselage. In this section, the duct is still in two halves, D shaped in section. The halves meet to form a complete cylindrical duct at the fume-tight bulkhead that is the forward end of the engine compartment.

Duct from Bulkhead Has Three Sections

The duct from the fume-tight bulkhead to the engine consists of three sections. The forward two sections are fuselage-mounted, and the third is engine-mounted. The first section is riveted to the bulkhead and incorporates a metal diaphragm, which allows the assembly, made up of the first and second sections, to articulate and align and seal with the engine-mounted duct when the engine is rolled in.

The second duct section has a fiberglass scroll or muff around it. Air is bled into the scroll through perforations in the duct wall. Use of ¼-in. holes instead of a slot prevents foreign objects from falling into the scrolls, where they would be unobserved during preflight inspection. The holes also prevent objects being sucked into the engine through the cooling duct system during reverse airflow experienced in ground operating conditions.

The third section has a similar scroll that directs cooling air into fiberglass ducting for the oil cooler and engine shroud. A series of "abalone shell" holes in the top of the scroll provide air for compartment cooling. A few of these scrolls have ruptured in maximum dive, so the failure area has been strengthened by additional fiberglass layers. A self-clearing ice detector probe is located in this third duct section. When the pilot selects automatic anti-icing, the detector and its interpreter cycle the anti-icing system as conditions require.

A simple compressor island fairing (Fig. 3) is possible because accessories are not mounted on the low-pressure compressor gearbox. Unused gears are left out to save weight. The fairing is a relatively blunt, double-walled aluminum assembly. Engine inlet guide vane anti-icing air is channeled between the walls and exhausts through an annular gap at the end of the nose cap, as shown in Fig. 4. Narrowing of this gap because of deflections caused in bolting on the cap resulted in partial failure of a few fairings because of increase in anti-icing air pressure. The loss of one aircraft during icing con-

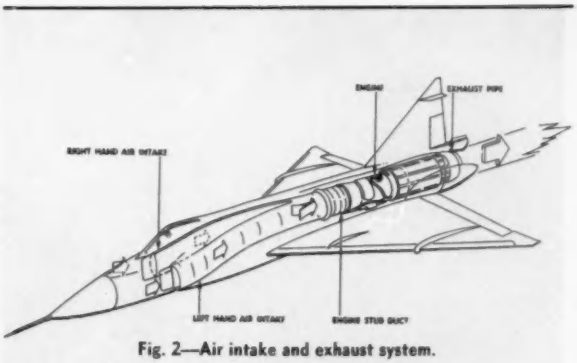
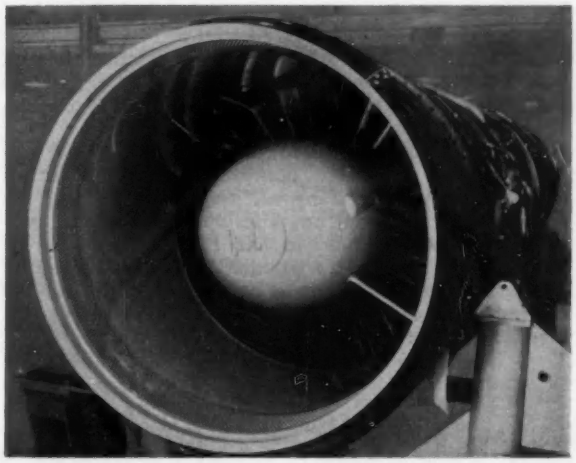


Fig. 2—Air intake and exhaust system.


Fig. 3—Engine inlet, showing cone and stub duct.

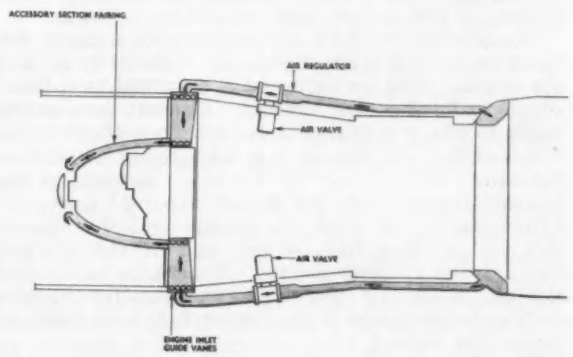


Fig. 4—Engine anti-icing system. Note that engine inlet guide vane anti-icing air is channeled between walls and exhausts through annular gap at end of nose cap.

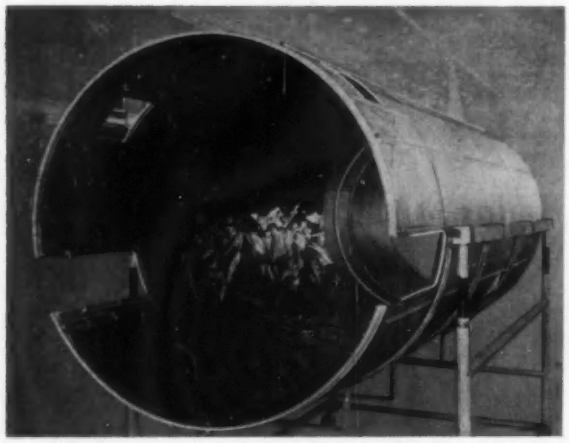


Fig. 5—Shroud cylinder, showing how it is lined with insulating blankets ½ in. thick, from engine fireseal to end of constant section.

ditions may have resulted from too small a gap, which throttled the system and rendered it ineffective. Increasing the gap and adding spacers to prevent deflections resolved the problem.

A strut from the fairing through the duct carries drainage from the compressor bleed governor seal and is anti-iced by air from the fairing. A temperature probe from the bleed governor protrudes through a hole in the fairing into the air stream. No seal is installed at this point because clearance around the probe provides venting for the fairing and duct static pressure sense for the engine bleed governor.

Engine Shroud

The engine shroud is a close-fitting insulated cannular type pioneered by Convair. The design concept calls for a fume-tight, liquid-tight firewall, which provides compartmentation for cooling purposes and protects the aircraft structure from engine heat. The result is a considerable saving in cost and weight, for aluminum aircraft structure can be used instead of titanium or stainless steel. Weight of the shroud with insulation is 140 lb.

The shroud envelope configuration is a large cylinder extending from the engine firewall to beyond the nozzle. The forward end is enlarged by a transition to fit the oval firewall. The aft end terminates in the frustum of a cone with a short cylindrical skirt. Cooling air is introduced at a point on the lower left side of the firewall. A baffle in the transition section distributes air around the engine. After passing between the engine and the shroud, this air is exhausted at the end of the aircraft through the annulus between the engine nozzle and shroud. One-inch diameter steel ducting provides overboard drainage if an engine fuel leak develops inside the shroud.

The shroud is manufactured in two main assemblies—the forward end, or adapter, which has three subassemblies hinged and latched together, and the main one-piece can with removable access doors. The adapter is held to the basic can by a titanium V band clamp.

The shroud is skinned with 0.012 rigidized commercially pure titanium sheets, reinforced with hat-shaped titanium-alloy rings inside and longitudinal "witches' hat" section stiffeners outside. Seamwelding is used extensively because it has proved to have good fatigue life. Monel rivets are used where required. Teflon impregnated asbestos is the sealing material used on access doors and joints that are not permanently assembled.

The shroud assembly is supported and sealed at the forward end on the engine firewall by the clamping action of the adapter sections. The aft end is supported by four adjustable titanium links to the fuselage. Fore-and-aft loads are borne by two longitudinal adjustable titanium links attached to titanium fittings bolted to the engine rear support flanges.

The shroud is lined (Fig. 5) with insulating blankets ½ in. thick, from the engine fireseal to the end of the constant section. Blankets play an important safety role because of the absence of a transverse firewall between the engine accessory section and combustion section. When a combustible fluid leak occurs in the accessory section, fluids and vapors are carried aft through the engine compartment by cooling air, then exhausted out the tail cone. It is imperative, therefore, that the external surface temperature of the shroud be kept below the autoignition point of the combustibles. Service experiences have proved this safety concept.

The blankets have a fiberglass insulating medium covered with stainless-steel foil. Hot-side foil is 0.002 in. thick and texturized to add body. The relatively cold side against the shroud is 0.002 in. thick and grooved for flexibility in conforming to the shroud shape. Washers, slipped over studs which are riveted to the shroud, hold the blankets in place. Cotter pins retain the washers on studs.

Cooling air for the shroud when the plane is in low-speed flight or on the ground is provided by bleed air from the last stage of the low-speed compressor. An engine port-mounted valve receives its signal from the landing gear down switch. Bleed air is carried through stainless-steel ducting into the shroud through a firewall check valve. This valve prevents reverse flow in the ram air system and provides firewall continuity when the engine is shut down. In-flight cooling is by means of ram air, carried from the second inlet duct scroll into the shroud via the check valve by fiberglass ducting.

More Rugged Shroud for J57-P41 Engine

The J57-P41 engine required a more rugged shroud because pumping action from its iris nozzle during afterburner operation tended to collapse a J57-P23 shroud. A few production shrouds in test aircraft collapsed at the aft end during limit dive. Failure was caused by high pressure differential in an area that originally did not have insulating blankets. The resulting high temperature reduced the structural integrity of the shroud. This deficiency was corrected by additional blankets and local "beef-up."

To Order Paper No. 232 . . .
. . . on which this article is based, turn to page 5.

New Techniques Solve Welding and Brazing Problems with PH Steels

Based on paper by

F. K. Lampson

Marquardt Aircraft Co.

PROBLEMS encountered in welding and brazing the PH (precipitation-hardening) steels include:

1. Cracked welds and low weld-metal ductility.
2. Oxidation of aluminum during the welding process.
3. Crevice corrosion of brazed joints.
4. Unsatisfactory bonds from normal brazing operations.

This article discusses techniques that are being used to overcome some of these problems.

The welding and brazing of the PH steels differ from the ordinary 400 series stainless steels in that they can be joined in the austenitic condition, where the susceptibility to cracking is decreased. To assure crack-free weldments, however, requires full consideration of the metallurgical characteristics of the material. Also, there appears to be an inherent problem of low weld-metal ductility which has not been fully resolved as yet.

Indications are that the 17-7PH, AM 350, and AM 355 steels should be fusion welded in the annealed condition, followed by the heat-treating operations to achieve maximum weld efficiency. For tungsten inert-gas arc processes, which are ideally suited for these materials, the filler metal should be of the same nominal composition as the base metal. In those cases where the material must be welded in the hardened condition, or where the strength of the weldment is secondary, it is permissible to fusion weld these materials using filler metal of the same type used for welding the austenitic stainless steels.

One problem which is inherent with 17-7PH steel is the danger of loss of aluminum by oxidation during the welding process.

Aluminum oxidation is decreased in the tungsten inert-gas welding process by using slightly higher argon gas coverage than is normally used for austenitic stainless steels. The argon gas provides a protective coverage which prevents oxygen from the air coming in contact with the aluminum of the steel.

Metallic arc welding of 17-7PH steel is normally accomplished using flux-covered electrodes of 17-4PH composition. Metallic arc electrodes of 17-7PH composition are not normally manufactured because the flux coating does not provide sufficient protection to prevent oxidation of the aluminum.

The fusion welding of A-286 alloy should be performed upon material in the annealed or solution-treated condition, since this alloy is highly susceptible to cracking during welding in the fully-aged condition. Considerable success has been achieved using filler metal of Hastelloy W (Ni base-Cr-Mo) composition where the technique favors dilution of the base metal. Several large consumers of this material, however, report considerable success using filler metal of base-metal composition, a situation which is to be preferred where the part is to be heat-treated after welding.

Brazing

Brazing of 17-7PH steels with brazing materials of the silver-manganese type has been widely accepted, primarily in the fabrication of honeycomb panels and structures. It has been reported, however, that the silver-manganese brazed joints are subject to crevice corrosion, and that considerable effort is being expended to correct this condition. Additions of lithium and nickel have provided varying degrees of success in reducing corrosion.

The brazing cycles are normally coordinated with the double-aging type of heat-treatment. As a result, 17-7PH steel provides about the ultimate in high-strength, low-density structures for use up to 800 F to 1000 F. Here again, however, the aluminum in the steel presents oxidation problems. So, brazing operations are carried out in dry hydrogen atmospheres.

In spite of this precaution, cases have been reported where the brazed assembly was covered with white powder (aluminum oxide) after the brazing cycle. Such a condition indicates that the aluminum content of the base metal has been depleted, a condition which is dangerous because the austenite becomes stable and full response to heat treatment is not realized. Naturally, this results in a weakened structure. It is believed that dry hydrogen atmosphere with dew points lower than – 50 F are required to prevent oxidation of aluminum during the brazing cycle.

There has been very little production brazing of

the AM 350 and AM 355 steels, but the composition would indicate that little difficulty would be encountered using the conventional brazing filler materials. This has been verified by several of the large airframe manufacturers.

The nickel-alloy brazing of A-286 alloy presents many problems due to the presence of aluminum and titanium. These elements are not reduced by hydrogen, so that normal brazing techniques performed in a dry hydrogen atmosphere are not sufficient to achieve reproducibly satisfactory bonds.

To support the theory that it is the presence of titanium and aluminum that create the difficulty when brazing A-286 material, it has been shown that as-forged parts, with one surface finished machined, have been found to bond perfectly along the as-forged surfaces but not along the machined surfaces. It is believed that aluminum and titanium, which are easily oxidized, are depleted from the as-forged surface—a condition which results in satisfactory bonding due to the increased wetability of the nickel-alloy brazing material and the base metal. At any rate, in one plant, the following procedure for nickel-alloy brazing has been found to work very well:

1. Subject the part to the brazing temperature and atmosphere in the absence of braze filler metal.
2. Vapor blast the parts.
3. Braze at 1950 F using AMS 4778 filler metal with a dew point of −60 F or better.

The vapor blasting operation removes the surface layer of titanium and aluminum thereby leaving a surface which is metallurgically clean to the brazing filler metal.

To Order Paper No. 216 . . .
. . . on which this article is based, turn to page 5.

Don't Forget Man . . .

. . . when designing equipment. For a variety of reasons, even automation isn't going to banish the need for human engineering.

Based on paper by **H. J. Bond,** Rand Corp.

"HUMAN ENGINEERING" denotes the role played by experimental psychology in the design of airplanes, automobiles, trucks, tractors, and other types of automotive equipment.

Its aims are:

1. Improved performance of the man-machine system.
2. Reduced training cost.
3. Better utilization of manpower.
4. Fewer losses from accidents and misuse of equipment.
5. Economical production and maintenance.
6. Great user acceptance resulting from matching equipment to the operator's abilities.

As an example of what can be done by human engineering, take a look at Fig. 1. Here we have a drawing of a conventional three-pointer altitude indicator together with an experimental version. How long does it take you to read the conventional one? The small pointer reads in 10,000's of feet; the broad pointer is in thousands, and the needle is in hundreds of feet. The correct altitude is 34,640 ft. Look at the experimental version. There is a single needle, and a counter which registers changes in altitude in thousands of feet. The indicator reads 8160 ft. When these two configurations were compared under controlled conditions, using experienced AF pilots and inexperienced college students, we got the results shown under the configurations. They speak for themselves.

Some designers assume operators to be like themselves, others think people to be morons in the handling of equipment. They may think the solution is to design equipment which doesn't need human operators, with the result that equipment is unnecessarily complex and may require a genius to maintain.

Similarity of operators is another assumption. This notion makes humans perform identically, endows them with similar size and physical characteristics, assumes like motivations, intellectual background, training, and experience. No one believes these assumptions, but we act as if they were true. The fact of individual differences is completely ignored.

Man versus the Machine

Man has his assets and his liabilities and they can be compared with the machine for the purpose of allocating tasks.

Man functions better than the machine in:

1. Sensory functions, especially where minimum absolute energy for sensory detection is concerned.

2. Perceptual ability. Man is good at sizing up complex situations quickly.

3. Flexibility. Man can change his mode of operation, shift his attention quickly without mental retooling.

4. Judgment. It isn't always possible to reduce operations to logical preset procedures.

5. Long-term memory.

Machines do better than men in:

1. Speed and power.

2. Routine. Machines do not become bored and inattentive with repetitive tasks.

3. Computation. When operating rules are built-in, machines are more efficient.

4. Short-term memory.

5. Complexity. Machines can perform more simultaneous operations.

Automation No Answer to All Problems

Automation is a long way from becoming the usual thing in industry and it will never entirely replace man. Here's why:

1. Machines wear out and break down. The more complicated, the more human functions it takes over, the greater the maintenance problem.

2. Not all control systems can be made fully automatic. Automation may only mean remote control.

3. Costs of automation are higher than those of human workers. This will delay universal application. It is unwise to try to build in to machinery functions the human operator can do better and cheaper.

4. Doubtless there will always be a class of machines which, through necessity or convenience, will be operated and controlled by individuals.

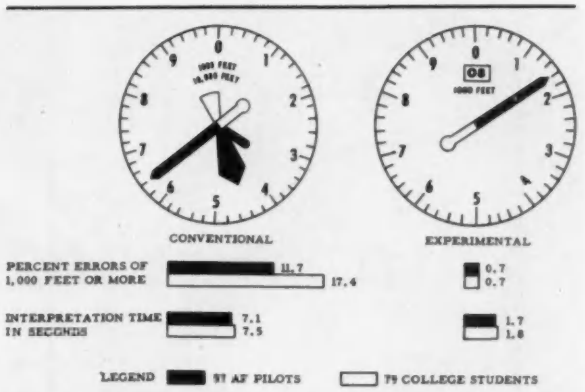


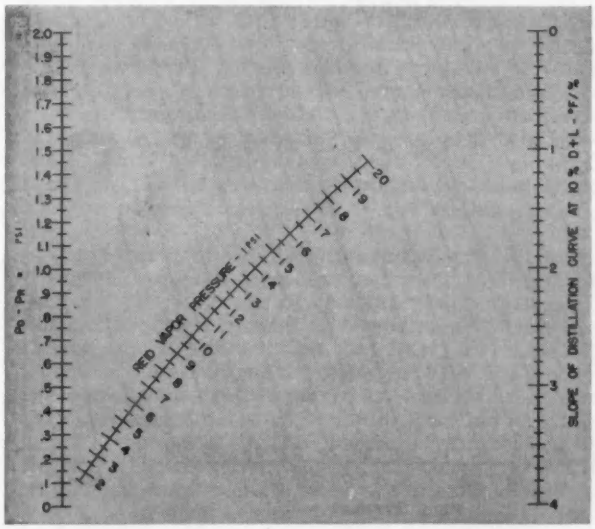
Fig. 1—An example of what human engineering can do in the design of equipment. Note how much fewer the errors of interpretation were with the experimentally designed altimeter.

Don't leave human considerations to the last phase of equipment design. Consider first the operator as a major component in the feedback loop controlling the equipment. What functions are to be assigned to the operator? What information does he need? How best can this information be given to optimize its use? What controls, workspace, and working environment will be most suitable? Consideration of these questions in the early design phase may save costly redesign.

To Order Paper No. 183 . . .
. . . on which this article is based, turn to page 5.

True Vapor Pressure . . .

. . . Calculations are made easy by simple conversions from Reid vapor pressure.



TRUE aviation gasoline vapor pressure can be easily found by combining a simplified test technique with correcting calculations given in CRC Report 290, "Vapor Pressure Relations of Gasolines." The Reid vapor pressure test is quick and easy to perform but gives answers only at 100 F and a volume-of-vapor to volume-of-liquid ratio, (V/L), of four. It is also assumed that the fuel is 80% saturated with air. To solve vapor lock problem the vapor pressure at any temperature and V/L ratio is needed. Reid vapor pressure can give this information by the use of three graphs, one equation, and the slope of the ASTM distillation curve at the 10% evaporated point (S).

Additional corrections for air saturation in the fuel are needed only if extremely accurate results are required. The following method is accurate, in most cases, to less than 0.1 psi. If greater accuracy

Fig. 1—True vapor pressure at 100 F and a zero vapor to fuel volume ratio can be calculated directly from the Reid vapor pressure (p_R) and the slope of the distillation curve at the 10% evaporation point (S).

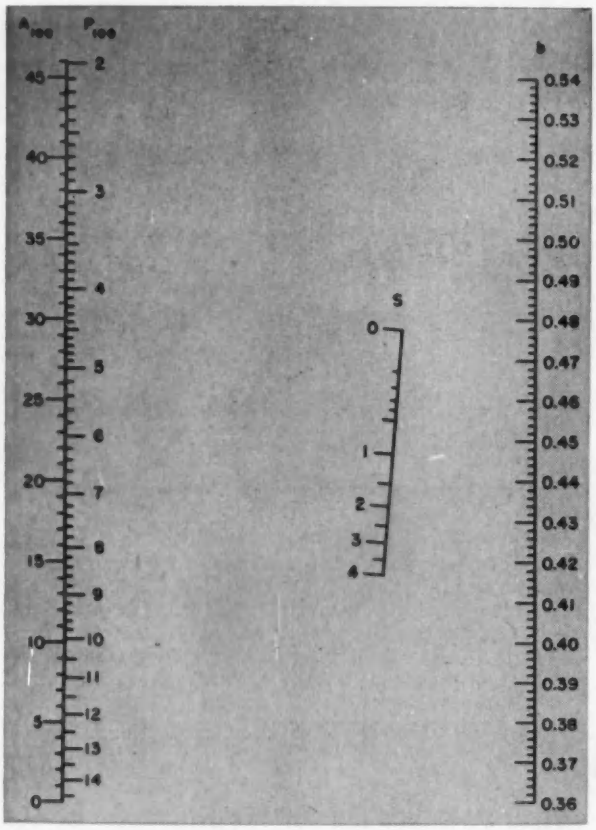


Fig. 2—Parameter b is used to get vapor pressure at any temperature and zero vapor to fuel volume ratio.

is desired, the report gives a refined correction for air saturation in fuel.

The first step is to get the true vapor pressure at zero V/L ratio and 100 F ($p_{0,\,100}$). Fig. 1 gives this true vapor pressure in terms of Reid vapor pressure (p_R), and the slope of the ASTM distillation curve (S). By first converting to at zero V/L baseline, future calculations are simplified.

Next the vapor pressure at any temperature and a zero V/L ratio is found. (It further simplifies the calculations to convert vapor pressure to an equivalent altitude function A, since A can be plotted as a linear function in the next step.)

The vapor pressure (p), or its equivalent (A), is determined for any temperature (t) and a V/L = 0 by:

$$A_{0,\,t} = A_{0,\,100} + b\,(100 - t)$$

where b and $A_{0,\,100}$ are read from Fig. 2.

Finally, the vapor pressure at any V/L ratio is found from Fig. 3. The curve is entered at the lower left with the fuel S value. This point is traced upward to the proper V/L ratio and then across to the line corresponding to the $A_{0,\,t}$ value calculated from the equation. The answer is read in terms of altitude or pressure at the top or bottom of the right hand side of the graph.

CRC Report 290 contains 140 pages including appendixes with graphs, scales and tables.

To Order CRC-290 . . .
. . . on which this article is based, turn to page 5.

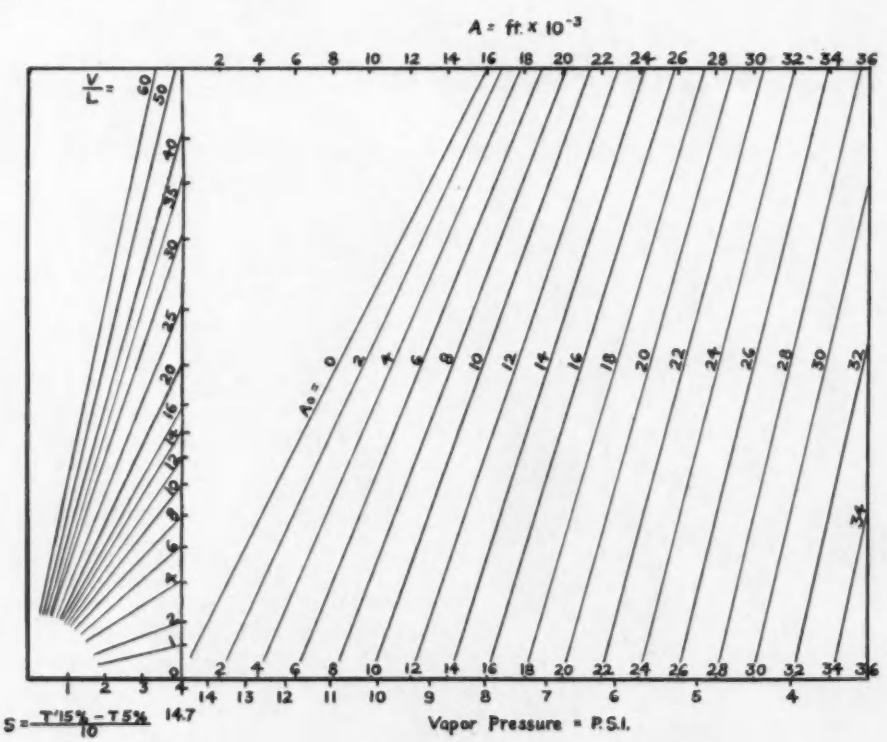


Fig. 3—Final results can be read from this graph—vapor pressure for any temperature and V/L ratio.

Looking Ahead in Fuels for Automotive Transportation

John M. Campbell
Research Staff, General Motors Corp.

A Prediction— and a Few Suggestions

PRESENTED herewith is the Horning Memorial Lecture for 1956.

After reviewing past accomplishments in the field of mutual adaptation of fuels and engines, Campbell predicts that a fuel of predominantly hydrocarbon composition will continue to be most suitable for automotive power.

In looking forward, however, he foresees that it will be important for us to take certain precautions to make best use of our present supplies of fuel and also to develop new sources of energy. Specifically, he urges that:

1. The automotive engineer take greater care in controlling mixture ratio, ignition timing, and other factors, including uniformity of product, in order to build into engines the maximum efficiency of fuel utilization.

2. We devote our best efforts to the discovery of entirely new processes of energy conversion —from chemical into mechanical or electrical energy.

3. We develop some means of utilizing either solar or nuclear energy on a large scale—to take care of the time when our fuel reserves begin to run low.

IN 1926, when I began my professional career, there were about 22 million registered passenger cars, trucks, and buses. Our annual petroleum consumption had reached the then all-time high of about 2 million barrels per day—about a quarter of what it is today—and many people were concerned about our future supply of gasoline. It was this consideration that led me to join the Fuel Section of the General Motors Laboratories at that time, because I believed that the automobile and the fuel to make it go were of great importance to the national economy.

The concept of octane number had not yet been invented, although there was beginning to be recognition of the importance of compression ratio and antiknock quality in relation to engine development. It was with this realization that Harry Horning interested himself in the development of a single-cylinder engine as an instrument for evaluation of the knocking characteristics of motor gasoline and offered the services of the Waukesha Motor Co. to make available such an engine. At that time there was considerable debate as to whether this engine should be of fixed-compression L-head construction or of a more costly variable-compression, overhead-valve construction. The variable-compression engine that was finally selected was later adopted by the American Society for Testing Materials and has become a worldwide standard for the determination of octane number.

At that time vapor lock had hardly been heard of, although there was recognition of the need of adjusting the volatility of motor gasoline in such a manner as to optimize the volume obtainable from crude, inasmuch as motor gasoline was then becoming the principal petroleum product.

Today we have 67 million registered passenger cars, trucks, and buses and the production and utilization of fuel to propel this great fleet of vehicles are a matter of direct concern to everyone.

The World's Greatest Power Industry

Taken altogether, the engines in our 67 million vehicles are capable of producing over 8 billion horsepower. This is more than 50 times the combined capacity of all the central electric generating stations in this country. Thus we are engaged in

•Looking Ahead In Fuels

continued from page 41

what is really the greatest power industry in the world. In contrast to the electrical industry, our horsepower is widely distributed and operates at a very low overall load factor. In another sense, if we consider fuel as the primary source of our power, the individual engines serve as local transformers, which convert the chemical energy in the fuel into motive power for individual transportation. In this sense the petroleum refinery corresponds to the electric central station and the filling station as the retail power outlet. Both the electrical and the petroleum power systems represent great interconnected networks reaching from the original sources of our fossil fuels located in the earth to the ultimate individual consumers.

Energy Distribution among Principal Sources

History will record the present century in which these great energy-distribution systems have been developed as the age of fossil fuel consumption. Our principal sources of energy are, of course, coal, petroleum, and natural gas. Water power, which is a form of solar energy utilization, represents only about 4% of the total.

During the past 30 years the utilization of petroleum and natural gas has been greatly expanded, whereas coal production has remained about the same in the face of increasing competition from oil.

A comparison between the principal energy sources since 1920 is shown in Fig. 1. Attention is called to the fact that energy scale on this chart is a logarithmic scale, and that on a linear scale the increase in energy consumption in recent years would appear even more impressive.

Coal has declined from producing about 80% our total requirements in 1920 to only about 30% in 1957. Coal has declined in relative position because of the availability of liquid fuels derived from petroleum and the economic transportation of natural gas long distances from the gas fields in the Southwest to consumers located as much as 2500 miles from the point of production.

Energy Distribution among Consuming Industries

Now let us look at how the energy is distributed among some of the principal consuming industries.

A comparison of the energy requirements in the United States for automotive transportation, commercial aircraft, rail, and marine transportation is shown in Fig. 2.

The dominating position of motor gasoline in the transportation industries is at once apparent from this figure. In 1956 we consumed a total of about 55 billion gallons of motor gasoline on our public highways, on our farms, and elsewhere, for which the American motorist paid approximately $16 *billion*.

Total coal production for all uses was approximately 475 million tons, which, at a cost of $8 per ton delivered, amounted to about $4 billion—about equal to the taxes paid on motor gasoline. The largest share of coal production was consumed by public utilities for generation of electric power, although space heating, manufacturing, and railroads each are important consumers.

Diesel oil used by the railroads in 1955 amounted to 81 million barrels and at a purchase price of $4.50 per barrel, came to a total of about $360 million.

Commercial aviation gasoline came to about 26 million barrels and at a purchase price of 19¢ per gal, cost the airlines about $200 million.

Distillate fuel oil for space heating is another important energy source. In 1955 about 440 million barrels were consumed. At 15¢ per gal, this cost the consumer almost $3 billion.

In total, domestic petroleum consumption is currently running at a rate of about 9 million barrels per day. It is expected that consumption of petroleum will increase at a rate of about 5% per year and that by 1967 our consumption will be at a rate of 15 million barrels per day. To produce this much oil the oil industry faces a staggering problem of exploration, drilling, transportation, and refining requiring large amounts of capital.

Reserves

This country has been richly endowed with fossil fuels—coal, crude oil, and natural gas—all of which have contributed importantly to our economic development. At current rates of production our proved reserves would indicate we had about 11 years' supply of oil on hand.

The figure for proved reserves does not allow for new discoveries, improvement in secondary recovery of oil from fields now existent, and for recovery of oil from oil shale and tar sands. Estimates of ultimate reserves from all these sources vary from 250 million barrels to over a trillion barrels. The latter has been estimated from shale alone, indicating at least that great potential sources of oil are available.

The recent opening of a commercial plant in Colorado to produce gasoline from Gilsonite marks a significant step in the direction of utilization of fossil reserves other than crude oil.

Overseas there are, of course, enormous supplies of crude oil both known and potential, but thus far only a comparatively small quantity of this oil has been imported into the United States.

Beyond this are enormous deposits of lignite, estimated at over 500 billion tons and over 1000 billion tons of bituminous coal, all of which can be converted to liquid fuels, if necessary, but at a rather extravagant loss of energy by known conversion processes.

Even further in the future is the utilization of nuclear energy in some form to produce power for automotive transportation. This time is so far in the future, however, that it would seem meaningless to attempt to speculate upon what form it might take when it may ultimately be needed.

The most obvious means would be to convert nuclear power into electrical energy and then to charge a storage battery which would propel the vehicle. The electric battery-driven car was in vogue over 50

years ago but was not competitive with the gasoline-propelled car for several reasons. Another possibility would be to use electrical energy produced from nuclear power to synthesize gasoline from water and carbonate rock. Any of these things could be done if we had to, but in all probability when the time arrives we will have developed some entirely new concept of energy conversion that we don't even have today. It may suffice to say in this connection that a much more critical problem immediately before us is to avoid destroying ourselves in the meantime.

Modern Gasoline is a Product of Research

The popular choice of the internal-combustion engine as the best form of power for automotive transportation was made early in the present century. Since that time gasoline has been transformed from an unwanted byproduct of petroleum refining to one of our principal and most indispensable sources of energy.

As the uses of the internal-combustion engine have developed, it has become more and more apparent that a reasonably volatile liquid hydrocarbon fuel is almost ideally fitted for automotive transportation. Few substances have a higher heat of combustion, and those that do have some other characteristics that quickly disqualify them for widespread automotive use.

Essentially, a liquid hydrocarbon is a molecular combination of carbon, which is ordinarily a solid, and hydrogen, which is ordinarily a gas having the highest heat of combustion per pound of any substance known. In liquid form this mixture of hydrocarbons that we know as gasoline is easily transported from the refinery to the consumer's gasoline tank and thence to the engine.

The volatile hydrocarbons are readily vaporized to form a premixed mixture of fuel vapor and air, which produces the cleanest-burning combustion that we know of. Furthermore, the products of complete combustion are carbon dioxide and water vapor —two completely colorless, odorless, and harmless gases in the concentrations in which they are ordinarily found in the atmosphere. This is particularly fortunate from the standpoint of air pollution. No known elements other than carbon, hydrogen, and oxygen, fulfill this important requirement.

Originally comprised of volatile hydrocarbons occurring naturally in petroleum and boiling between 100 and 300 F, gasoline has now become a mixture of hydrocarbons, most of which did not occur as such in the original crude oil at all, but which have been literally synthesized in the refinery and boiling over a wider range in order to increase the yield of gasoline from available materials.

Compression Ratio—Key to Higher Engine Efficiency

Compression ratio was early recognized as the key to higher engine efficiency, but in the early years engineers were limited by the knocking tendency of the naturally occurring hydrocarbons in gasoline. It was not until the investigations of Kettering and his associates that it was recognized that the knocking tendency of fuels could be modified either by the addition of an antiknock agent such as tetraethyl lead or by changing the molecular structure of the fuel itself. The possibilities of changing the molecular structure of the fuel and the systematic relationship between molecular structure, knocking tendency, and lead susceptibility became more fully apparent upon the publication of the investigations of Lovell, Campbell, and Boyd at the General Motors Research Laboratories.

These studies were later coordinated with the fun-

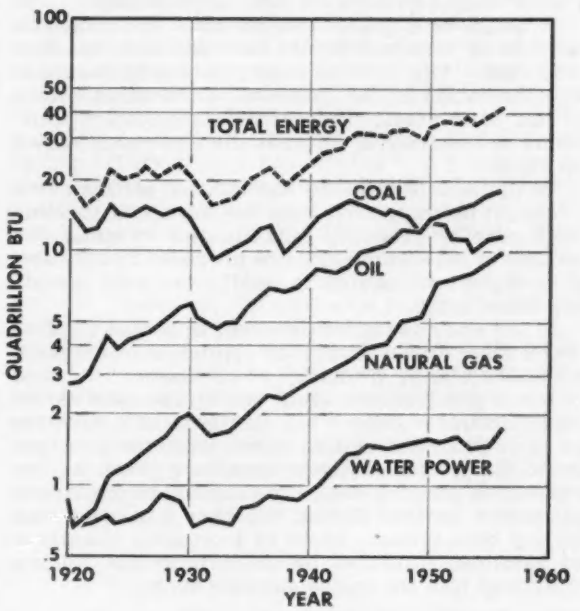


Fig. 1—Energy consumption in U. S. by sources.

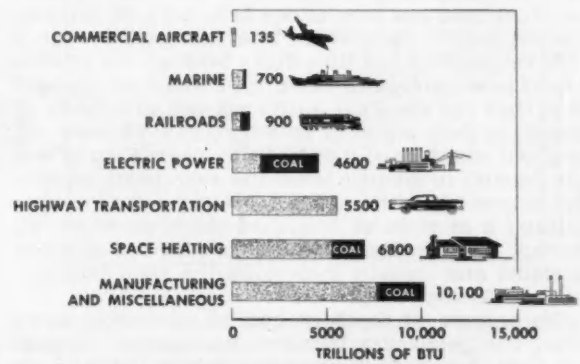


Fig. 2—Energy consumption in U. S. by end uses in 1955 (estimated in trillions of Btu).

•Looking Ahead In Fuels

continued from page 43

damental research program of the American Petroleum Institute.

This knowledge of the influence of molecular structure on knocking tendency, coupled with an urgent desire to increase the yield of gasoline from crude petroleum, led to an intensive investigation of processes for increasing the yield of gasoline from crude and at the same time increasing the octane number so that compression ratio and resultant higher engine efficiencies could be obtained.

It would be impossible to estimate the enormous amount of time and money that has been spent in this field. The very extensive patent literature is one indication of the intensity of the effort over a period of 30 years. But the most significant testimony to the scale of effort is the end result shown in Fig. 3.

To appreciate fully the significance of this curve it should be recognized that the volume of gasoline that is being produced today is over 15 times the volume of low-octane gasoline produced in 1920 and at no significant change in retail price, even including extra taxes.

In the early years improvement in octane number was a more or less fortuitous byproduct of cracking processes aiming primarily at increasing the yield of motor gasoline from crude oil. In the more recent years octane number itself has been the objective of such processes as alkylation, isomerization, hydroforming, and catalytic reforming, even at the expense of reduced yield. The gradual improvement in octane number during the past five years has largely been brought about by increasing quantities of gasolines produced by these processes finding their way into the motor gasoline supply.

Tel First Introduced in Gasoline in 1923

Tetraethyl lead, first introduced in premium gasolines in 1923 and later in regular gasoline in the early Thirties, has added continuously to the rising octane level, although improvements in the base gasoline to which lead has been added have been responsible for the greater share of the total increase.

It is typical of the time delay between the discovery of new information and its commercial application that the excellent antiknock characteristics of isooctane first reported by Edgar in 1927 were not realized commercially until 1934. Even then it was not feasible to produce isooctane alone commercially but rather a product of the alkylation reaction containing a mixture of branched chain paraffins, all having high antiknock value suitable for aviation gasoline and thereby increasing the yield of high-octane blending stock.

On account of the high cost of alkylation, however, the petroleum industry has sought cheaper processes for producing motor gasoline. These have been, successively, catalytic cracking and more recently catalytic reforming. Some commercial premium gasolines today are in the vicinity of 100 octane number—meaning they are equal to pure isooctane, the reference standard, in resistance to knock.

The production of the large quantities of high-octane gasoline that are required today is a truly remarkable achievement of American industrial research and technology. The American motorist and the public at large are the direct beneficiaries in every way that they are affected by either commercial or passenger-car transportation.

In addition to the three primary considerations for motor fuel, namely, heat content, volatility, and resistance to knock, there are a number of important secondary characteristics that affect the operation of a gasoline in an engine over an extended period of time. Most of these characteristics are influenced by supplemental chemical additions to the fuel. Among these are substances tending to have the following effects:

1. Scavenge combustion-chamber deposits.
2. Reduce deposit formation either in the induction system or the crankcase.
3. Reduce spark-plug fouling.
4. Prevent oxidation in storage.
5. Prevent rust formation in fuel systems.
6. Prevent ice formation.
7. Reduce surface ignition.
8. Provide color for identification.

In using such materials in gasoline it has been necessary to exercise great care in working out suitable formulations in order to insure three-way chemical compatibility between the composition of the fuel and all of the mechanical parts of the engine and the lubricating oil. Many of these materials that are used commercially in motor fuels today are of a proprietary nature, although their value has been well established by expensive and painstaking service tests. They have contributed importantly to the overall reliability and satisfactory operation of the motor vehicle.

Tools for Measuring Knock

For the past 25 years the organization with which I have been associated has supported a vigorous program of fundamental research on the production of power in the internal-combustion engine in order to obtain the greatest possible efficiency of fuel utilization. These investigations have ranged from a study of the influence of molecular structure on knocking characteristics previously mentioned, flame and combustion studies, to careful examination of the effects of ignition timing, air-fuel ratio, combustion-chamber design, valve timing, valve cooling, piston cooling, transmission and rear-axle design.

Our first experiments with really high compression engines date back to 1926 when we built, at considerable cost it seemed to us in those days—about $20,000—a single-cylinder, variable-compression engine capable of operating up to 15/1 in com-

pression ratio. It was my privilege as a young man just out of college to experiment with this engine and to explore the wide spectrum of fuel characteristics and engine operating conditions that were within reach of this engine. It was further my good fortune to have been associated with C. F. Kettering, T. A. Boyd, W. G. Lovell, L. L. Withrow, G. M. Rassweiler, and P. L. Cramer, all of whom greatly assisted in the development of the new knowledge concerning fuels and combustion that was being accumulated almost daily during this period.

One of the first things we did was to determine the effect of various engine variables such as compression ratio, speed, spark advance, jacket temperature, air inlet temperature, and air-fuel ratio on knock. Some of our measurements were made by ear and some were made using the bouncing pin indicator. It was during these investigations that we became cognizant of the important influence of air-fuel ratio. Prior to that time the tacit assumption had been made that all fuels responded alike to changes in engine variables. The discovery that different fuels responded differently to air-fuel ratio was very significant. It not only accounted for wide discrepancies between fuel evaluations made by different laboratories, but, more importantly, it led to the standardization of the air-fuel ratio for maximum knock for future knock testing, thus greatly improving the reproducibility of the test.

Later, in 1929, we developed a variable-compression knock test procedure using the air-fuel ratio for maximum knock, spark advance for maximum power, jacket temperature 212 F, and an engine speed of 600 rpm. During these investigations we became cognizant of several advantages of isooctane as a reference fuel over several other proposed reference fuels. The knowledge we had obtained in these experiments was influential in the subsequent adoption by the CFR Committee of a variable-compression engine built by the Waukesha Motor Co. and operated under substantially these same engine conditions for the standard knock test in 1931. This method later became known as the "Research" method to distinguish it from the "Motor" method and, with minor modifications, is still in use today.

The then new knock test procedure had been in use for less than a year when it became apparent that the method had certain shortcomings with respect to correlation with road ratings. This called for an extensive and industry-wide investigation of road and laboratory evaluations of the knocking tendencies of a wide range of motor fuels in 1932. Horning took a close personal interest in this program even in the depths of the depression years, and it was at that time that he invited the Detonation Subcommittee to use the facilities of the Waukesha Motor Co. as a laboratory for working out any modifications of the test procedure that seemed necessary to give a more significant correlation with road tests made in that year by the CFR Committee at Uniontown, Pa. Here again we drew from previous experience that I had obtained several years earlier. This greatly accelerated our progress, so that in three weeks we were able to recommend a modified test method known as the "Motor" method, which was adopted by the CFR Committee. This method also is in use today, although it has a secondary position having been superseded by the original "Research" method as a result of changes made in more recent automobile engines.

Looking back over the events that took place in those years, I think they were particularly significant for two reasons. In the first place, a dependable yardstick for the measurement of knocking tendency was established. This enabled the petroleum industry to measure this important property of gasoline and to progress upward along the curves shown in Fig. 3 as fast as new technology and com-

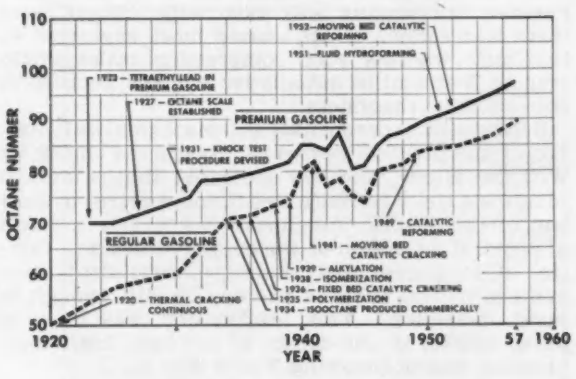


Fig. 3—Steady trend toward increasing octane number reflects truly remarkable changes in refining technology over the past 30 years.

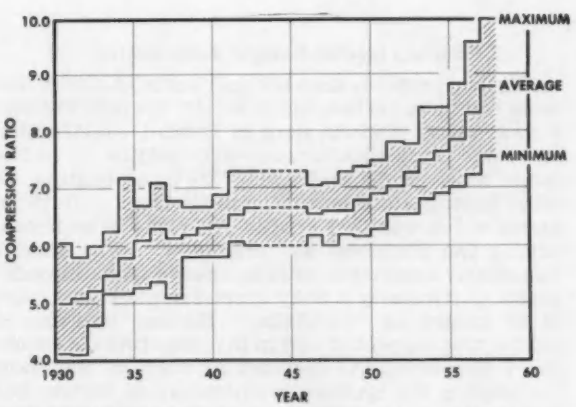


Fig. 4—Since 1930 automotive compression ratios have climbed from an average of 5.0/1 in 1930 to 8.8/1 in 1957.

•Looking Ahead In Fuels

continued from page 45

petitive economics would permit. In the second place, the programs brought about a better understanding of the entire fuel and engine problem among men who were later to exert an important influence toward progressive developments in fuels and engines in their respective organizations. I believe this accounts to an important degree for the upward trend in the octane curve shown in Fig. 3 and for the trend in compression ratios shown in Fig. 4.

Statistical Concepts Advocated

One of the fundamental problems in connection with the making of measurements of any kind is the estimation of the reliability of the measurements themselves. In this respect the measurement of knocking tendency is no exception and, along with the development of laboratory and road test procedures, we were very much concerned about the variability of the measurements we were getting.

At about this time the statistical sciences were being developed to a point where they could be usefully applied to the analysis of the type of experimental data that we were concerned with in the measurement of knock.

In 1938 we made a beginning in the application of statistical concepts to the knock rating problem with the aid of Prof. H. C. Carver of the University of Michigan. These studies led to the introduction of statistical procedures first in the analysis of laboratory and road test knock ratings and later in the determination of the octane-number requirements of automobiles. Today these procedures are widely accepted for the determination of the degree of confidence that can be placed upon data relating to knock in automobiles.

Surface Ignition Brought under Control

Another problem that became acute at about this same time was surface ignition. In the late Thirties a good many engines were of L-head construction and some compression ratios were getting up in the range between 6.5 and 7.5/1. In these engines we were having considerable trouble from a form of knock which was very erratic and came to be known among the engineers as "wild ping." The trouble was clearly associated with combustion-chamber deposits, particularly a flaky type of deposit that came to be known as "cornflake." Surface ignition, of course, was suspected and in investigating this problem I discovered the spectacular effect of lead salts in lowering the ignition temperature of carbon and in inducing a cigarette-type of glowing combustion in carbon particles. This led to a search for substances which would prevent the glowing of carbon particles. It was soon found that substances such as phosphates, borates, and silicates which had been previously known as flameproofing materials for fabrics, were very effective in preventing carbon from glowing in experiments made outside an engine.

Later engine experiments showed that organic phosphorus compounds could be introduced with the fuel to produce combustion-chamber deposits that were less susceptible to surface ignition. This work was interrupted during World War II and it was later found that phosphorous compounds had a favorable effect on spark-plug life under certain conditions. Although these effects on surface ignition and spark-plug fouling have been much more difficult to evaluate than the effect of tetraethyl lead on knock, for example, a great many gasolines today contain small amounts of some phosphorus compounds in order to attain these beneficial effects.

Evolution of the High Compression Engine

Ever since the introduction of Ethyl gasoline in 1923 there was considerable interest in high compression as a means of adding to the performance and economy of commercial engines. Several automobile companies had offered optional high compression cylinder heads for their standard engines and they had wide acceptance. The increase in compression ratio that could be accomplished in this manner was limited by the commercial fuels that were available and so we were seldom able to move in increments of more than one compression ratio at any one time.

In 1934 our laboratory took a step that had far-reaching significance toward the evaluation of the possibilities of really high compression ratios in multicylinder engines that were far in the future. In that year we built an 8-cyl overhead-valve engine having a compression ratio of 10.3/1 and installed it in a car. At that time the average compression ratio for passenger-car engines was about 5.5/1. This engine having a compression ratio of 10.3/1 showed spectacular performance and fuel economy, but its fuel requirements in terms of octane number were far out of reach of any fuels that could be conceived of commercially at that time. Further, the engine was extremely "rough" and there was serious doubt among most engineers at that time whether such compression ratios would ever be practical in automotive engines because of objectionable roughness.

Subsequent experimental and mathematical analysis of the physical causes of "roughness" made by Withrow, Stone, and Fry indicated that, although roughness could be controlled to some degree by control of combustion, roughness was largely a result of physical deflection of the engine structure. Control of roughness was, therefore, dependent upon making critical parts of the engine stiff enough to resist deflection. This information was later to prove helpful in the design of our next high compression engine following World War II.

After the war an important step in the chain of events leading to the modern gasoline engine was taken in 1947 when Kettering called attention to the possibilities of further improvements in engine efficiency that could be had if fuels could be made available that would permit compression ratios as high as 12/1. A car having a 6-cyl, overhead-

valve engine with 12/1 compression ratio and greatly improved fuel economy was demonstrated at a meeting of the Society of Automotive Engineers in that year.

This engine also demonstrated that, with proper attention to structural design, an automotive engine can be operated at such high compression ratios without unacceptable sacrifices in smoothness. In fact, this was one of the most impressive conclusions of this demonstration because prior to that time the opinion was widely held among engineers that such compression ratios would be impractical for automotive engines because of unavoidable roughness. Although the difficulty of producing sufficient quantities of higher octane fuel was recognized, this demonstration provided sufficient confidence in the possibilities of higher compression ratios to establish an incentive to produce postwar fuels of increasing octane number together with engines of gradually increasing compression ratio. Commercial engines of V-8 overhead-valve configuration were introduced by Cadillac and Oldsmobile in 1949 with compression

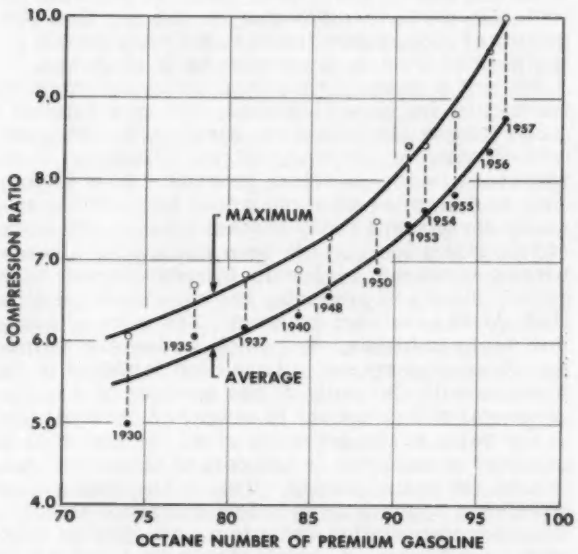


Fig. 5—Composite relationship between compression ratios in passenger-car engines and corresponding national average octane numbers of premium gasoline.

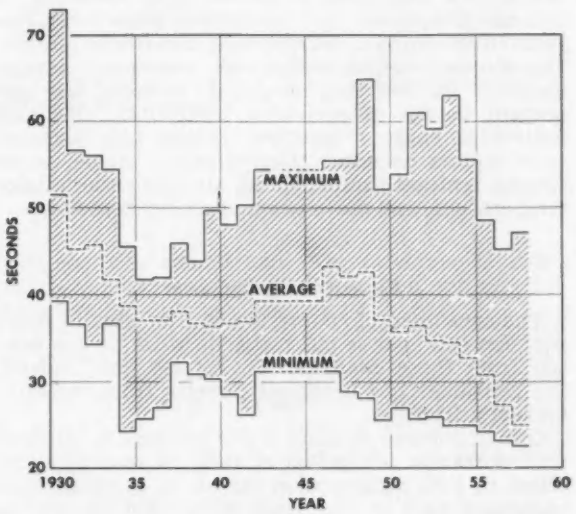


Fig. 7—Average time required to climb 11.6% hill has been reduced by 50% since 1930.

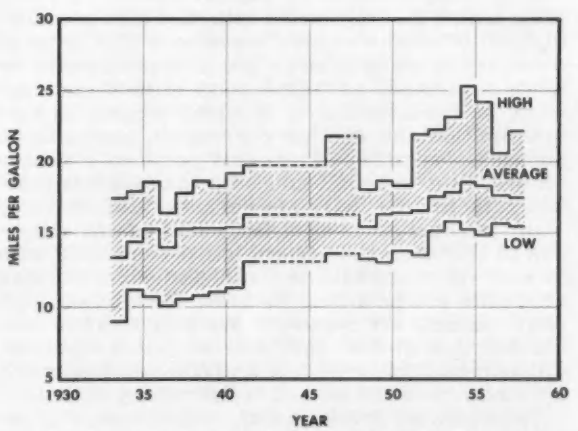


Fig. 6—Since 1933 there has been an improvement in average highway fuel economy of 30%. Postwar designs peaked in 1954, and since that time emphasis on performance has more than offset gains in engine efficiency resulting from increasing compression ratios.

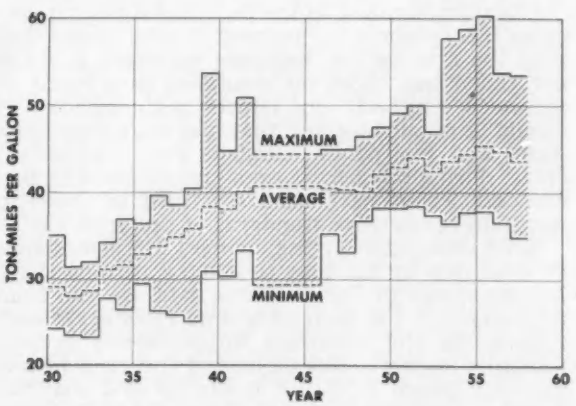


Fig. 8—Since 1930, efficiency of average American passenger-car engine as measured by its ability to propel a motor vehicle at 40 mph has increased 50%.

•Looking Ahead In Fuels

continued from page 47

ratios in the range between 7 and 8/1.

The end result has been a gradual increase in compression ratio from an average of 5.0/1 in 1930 to 8.8 in 1957, as shown in Fig. 4. The highest compression ratios in production today are 10/1.

An interesting correlation between the average octane-number premium gasolines sold in the United States and the average compression ratio each year is shown in Fig. 5. This relationship, of course, is a very general one but it is sufficient to indicate the trend that has taken place over the years in obtaining a commercially acceptable matching of compression ratios with increasing octane number. It does not, of course, indicate the important details of matching individual fuels and individual engines together, taking into account such factors as combustion-chamber shape, valve timing, ignition timing, speed, air-fuel ratio, intake temperature, and combustion chamber deposits.

Pay-out to the Consumer

The consumer, of course, is not interested in compression ratio per se but rather in what he has gotten from these changes. Let us see how, indeed, the consumer has benefited directly from research on fuel utilization.

One important measure is the increase in miles of transportation per gallon of fuel. A record of the trend in fuel consumption for all U. S. production passenger cars in the years from 1933 to 1957 is shown in Fig. 6. These data were obtained by the General Motors Proving Ground staff from actual highway tests under comparable driving conditions on a 300-mile course that includes both city and open highway driving. The data show that the average has increased from 13.5 mpg in 1933 to 17.4 mpg in 1957—an increase of 30%.

Attention is called to the fact that a peak in average fuel economy was reached in 1954. Since that time the average fuel economy expressed in miles per gallon has fallen off somewhat as a result of increased emphasis on vehicle performance. It should be noted, however, that had not compression ratios and fuel octane numbers continued to increase during this period, even greater losses in fuel economy would have been sustained in order to maintain competitive standards of performance.

Some conception of the changes in performance as measured by the time to climb a certain 11.6% hill are shown in Fig. 7. These data are also from the records of the General Motors Proving Ground. Considering the important improvements in performance shown in this figure and the gains in fuel economy shown in Fig. 6, it can be said that the American motorists has really been able to "have his cake and eat it too."

Possibly the most impressive measure of improvement in engine efficiency alone, independent of performance and car weight, is expressed in Fig. 8, where ton-miles per gallon at 40 mph is shown for the same group of American pasenger cars at the General Motors Proving Ground. In the period from 1930 to 1957 the average has increased from 28.9 ton-miles per gal to 43.6 ton-miles per gal. This is an increase of about 50%—a very remarkable improvement. Perhaps it should be noted that, although these calculations are based on the arithmetic average of all cars, weighting of the average in accordance with car registrations did not affect the result significantly—the increase was 50.6%.

That this increase is not confined to this particular speed is shown by the fact that the highway fuel economy data shown in Fig. 6, when converted to a ton-mile per gallon basis, indicate an average increase from 26.7 in 1933 to 39.8 in 1957. This again is an increase of about 50%. It is on the basis of such information as this that we can say that two gallons of today's gasoline in today's engine will do the work of three in the engine of 25 years ago.

When it is realized that these gains are made in relation to the present annual consumer expenditure of about $16 billion for gasoline, we get some idea of why the efficiency of fuel utilization is so important to the American motorist. It is impossible to determine what we would be spending annually for gasoline today if these gains in efficiency of fuel utilization had not been made. Our already heavily burdened petroleum industry would have great difficulty in producing the additional gasoline that would have been required. The price of gasoline would be higher. Our whole automotive transportation economy would have been inhibited in its development. Certainly we are speaking of a factor of several billion dollars in magnitude comparable to the value to the consumer of all the coal that is produced annually or to the cost of all the oil that is used for space heating. This is the measure of significant improvements in fuel utilization in automotive transportation because we are dealing with such large figures. A saving of only 6% in total fuel consumption is worth about a billion dollars annually. At the same time it greatly relieves the strain on petroleum production and the life of our valuable fuel reserves.

With many commercial engines now at 10/1 and going higher in compression ratio and with premium fuels at 100 octane number, we have reached a point where not much is to be gained in fuel efficiency by further increases in compression ratio alone. Already we are conscious of problems created by surface ignition and another combustion phenomenon known as "rumble." From this point on I believe we will want to retain and even increase compression ratio in order to retain our part-load efficiency —and we operate at part-load most of the time— and at the same time retain our performance with smaller displacements and utilizing supercharging or engine compounding in some form when high power outputs are required. We may want to take another look at dual fuel systems, water injection, supplemental fuel injection, and other devices which until now have not seemed commercially feasible.

Transmission developments, too, will need to receive careful consideration. However, both superchargers and transmissions will require a great deal of development before satisfactory noise level, durability, efficiency, and low cost can be attained.

Ten years from now, barring war, we will prob-

ably have in the vicinity of 80 million registered vehicles on the highways of this country. The Federal Highway program will do much to make room for these vehicles on the road. By that time we will be consuming gasoline at a rate of 65 to 70 billion gallons annually. The rate at which we actually use gasoline at that time will depend somewhat on trends in automotive engine design and efficiency. Because of the large production of automotive engines, the engineer has an unparalleled opportunity to "find" new oil fields simply by using gasoline more effectively and thereby making it unnecessary to find certain oil fields that would otherwise have to be found and tapped.

In any one year the effect would be small but since the effect is cumulative over a 10–15 year period during the life of the average car, it can continue to be very significant, as has been shown in the past.

I believe hydrocarbons in the general form of gasoline as we know it today, with certain modifications in volatility and molecular structure for optimizing fuel economy and combustion characteristics, will remain for many years as the most suitable form of energy for automotive transportation. However, we do need some more efficient means of converting what we broadly term as chemical energy into mechanical or electrical energy. The best of our present heat engines are very wasteful, over 60% of the heat being wasted in the best of them and more often as much as 80% of the original energy supplied is wasted. This problem is an old one but it is daily becoming more important to us as we expand our use of energy. We are wasting far more than we use just as we used to run gasoline down the rivers alongside the refineries at the turn of the century. A real technological break-through is needed to accomplish this, although it might come from some greatly improved form of thermoelectric or electrochemical energy conversion process. At the present time, of course, no one has the slightest idea how such a thing could be accomplished commercially.

Air Pollution

One of the byproducts of the struggle for more efficient combustion concerns atmospheric pollution from automotive exhaust gas. As was pointed out earlier in this discussion one of the natural advantages of hydrocarbon fuels is that they can be burned to carbon dioxide and water vapor, both of which are quite harmless from an air pollution standpoint. The trouble is that as a practical matter it is difficult to achieve ideal combustion under the wide range of operating conditions under which an engine is called upon to operate.

Because maximum power is obtained with a mixture that is somewhat on the rich side of the mixture for complete combustion, most carburetors are designed to operate on a slightly rich mixture when the driver is calling for power. Moreover, even when cruising at part-load where a mixture ratio for complete combustion will suffice to produce the power required, a somewhat rich mixture may be found to produce a more immediate response to calls for an increase in power.

For this reason carbon monoxide and hydrogen are generally present in exhaust gas and their concentration is indicative of the degree of departure from complete combustion. The fundamental relationships between exhaust composition and air-fuel ratio were studied by Lovell and D'Alleva.

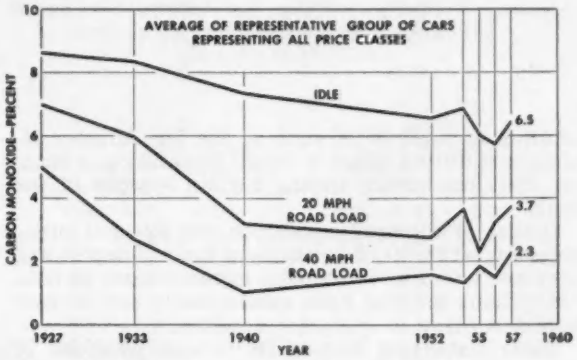


Fig. 9—Although there has been a significant reduction in carbon monoxide since 1927, there has not been any improvement since 1940, as indicated by these averages.

Thirty years ago there was much concern about air pollution in crowded city traffic such as that found in New York City. Both carbon monoxide and lead poisoning have been the object of various investigations but no evidence of harmful concentrations or of proved deleterious effects have been identified.

It is significant that carbon monoxide concentrations have been reduced with respect to what they were in the Twenties and early Thirties but that since 1940 there has not been much change in the carbon monoxide content of automotive exhaust gases, as indicated by the information presented in Fig. 9. In this figure a comparable group of passenger cars representing all price classes is compared over the period from 1927 to 1957. The fact that it is not unusual to find cars producing less than one per cent carbon monoxide at road speeds between 20 and 60 mph is an indication that, with proper attention to carburetion and appropriate methods of inspection, a further reduction in carbon monoxide could be obtained if we were really determined to take the trouble to get it. At the same time a corresponding improvement in fuel economy would be obtained.

More recently the smog problem in Los Angeles has called attention to the desirability of reducing traces of oxides of nitrogen and unburned hydrocarbons from exhaust gas. It is now believed that, under the conditions of atmospheric inversion that prevail in Los Angeles and other West Coast cities, traces of hydrocarbon, that is, one or two parts per million, react with corresponding amounts of oxides of nitrogen in sunlight to produce certain compounds that produce eye-smarting, plant damage, and atmospheric haze. A characteristic of this reaction is the formation of ozone and other oxidizing substances which may be found in concentrations

•Looking Ahead In Fuels

continued from page 49

totaling as high as 1.0 ppm in the Los Angeles atmosphere during hours of bright sunshine as a regular daily occurrence during certain seasons of the year.

Oxides of nitrogen appear in the exhaust products of most forms of combustion to some degree and they are found in automotive exhaust gases in concentrations ranging from substantially zero to 5000 ppm according to operating conditions.

Some unburned hydrocarbons and products of partial oxidation are also found in gasoline-engine exhaust gas. It is believed that these are derived principally from two sources. During deceleration at high intake manifold vacuum it has been shown that combustion in the cylinders is incomplete due to high dilution of the incoming charge with residual exhaust gas and that some hydrocarbons escape combustion in portions of the mixture that are not reached by the flame. In 1956 the Horning Award was presented to Wentworth and Daniel for their investigations which clarified this subject and indicated certain steps that might be taken to reduce the amount of hydrocarbons in exhaust during deceleration.

Further than this, however, traces of hydrocarbons and partly oxidized hydrocarbons are found in exhaust gases even under normal cruising and full-power operation. As a result of the investigations of Daniel at the General Motors Research Staff, it is now believed that these hydrocarbons are derived from the thin film of gases that is compressed next to the combustion-chamber walls and where combustion is prevented by the quenching action of the relatively cool combustion-chamber walls. It is estimated that 1–3% of the original fuel supplied to the engine escapes combustion in this manner.

It is often proposed to eliminate the combustibles in exhaust simply by burning them in an exhaust burner. One of my earliest assignments at the General Motors Laboratories in 1926 was to investigate the inflammability of exhaust gas with a view toward this as a means of eliminating carbon monoxide. It was soon found that the amount of combustible gases in a properly carbureted engine produced an exhaust gas that was not combustible at the temperature of exhaust gas.

In my experiments I found that it was not possible to ignite an exhaust gas-air mixture containing less than 7% carbon monoxide and that, after ignition had been started with a rich mixture and the burner warmed up, it was not possible to maintain continuous combustion with an exhaust gas-air mixture containing less than 3–4% of carbon monoxide. This is a richer mixture than most cars of today are using, as shown in Fig. 9. In making this comparison it should be noted that the carbon monoxide values shown in Fig. 9 apply to the exhaust gas alone. After dilution with the air required for combustion, the carbon monoxide content of the exhaust gas-air mixture would be reduced.

This conclusion was confirmed by G. W. Jones at the U. S. Bureau of Mines in 1928. Although Jones' experiments were carried out at room temperature and did not take into account the water vapor present in exhaust gas, Jones concluded that the compositions of exhaust gas that were combustible were considerably richer than those ordinarily found even at that time.

Since it is clearly evident that normal compositions of exhaust gas are not combustible, we are today searching for a suitable catalyst that will bring about oxidation of the combustibles in exhaust gas at lower temperatures than those required for inflammation. Within the past year we have had considerable encouragement although it is still too early to say whether a commercially satisfactory catalyst will be found.

The control of oxides of nitrogen and hydrocarbons in exhaust gas to minimize undesirable air pollution is a difficult problem that is now receiving a great deal of study by the Vehicle Combustion Products Committee of the Automobile Manufacturers Association and by the Coordinating Research Council. I am confident that the investigations now under way will develop the knowledge that is needed at least to minimize air pollution from automotive exhaust gases.

Another source of losses of hydrocarbons is at the carburetor vent. Although the automotive engineers have had considerable success in designing engines to operate on fuels of high vapor pressure in warm weather, it has been found that at the same time significant amounts of fuel may be vented at the carburetor. If the vapors are vented internally they only go to make the mixture richer; they do not give the customer any return. Likewise, if the vapors are vented externally, the customer gets nothing in return for that portion of the fuel that is vented and the community gets that much additional hydrocarbon pollution.

This is really just one part of the larger problem of designing fuel systems for handling boiling liquids. Only recently has anyone done much of anything to determine just what happens in a fuel pump when it is pumping gasoline at various temperatures. Still more recently a new concept for the measurement of the vapor-locking tendency of motor fuels has been introduced which I believe will be more satisfactory than the Reid vapor pressure measurement, which has been commonly used up to now.

The advent of 4-barrel carburetors, 8-barrel carburetors and fuel injection has given rise to many operational problems concerning fuel volatility. Too often automotive engineering in respect to fuel systems has been merely a matter of assembling the required components in the most convenient manner without regard for the material the fuel system must handle, that is, boiling gasoline. This is a problem of long standing that will require even more careful study by the oil and automotive industries, again to minimize losses of the energy that has been so carefully prepared at the refinery and further to reduce atmospheric contamination.

Better Fitting of Engines and Fuels— a Continuing Responsibility

As long as we have the present form of gasoline

engine, the automotive engineer will have a strong incentive to push compression ratios as high as available fuels permit in order to obtain the highest operating efficiency over the entire operating range of speeds and loads. In 1926 I believe I was the first one to show that it was possible to raise the compression above that permissible to obtain full power with fully advanced spark, and then to retard the spark to control knock without losing the original power. By utilizing this principle it is possible to operate at a high compression ratio with retarded spark at full throttle and then to advance the spark for part-throttle operation to that for maximum power, thus enabling the engine to be operated at a higher compression ratio at all times than would otherwise be possible. Today this is accomplished in a practical way with a combined vacuum and centrifugally controlled spark-advance mechanism. The full-throttle spark may be even further retarded enough to give a loss in power of from one to five per cent. However, in the transition between full-throttle timing and part-throttle timing it is necessary to maintain careful control of the ignition timing or "part-throttle" knock may take place at any speed. Here it is sometimes desirable also to take advantage of the influence of air-fuel ratio to control knock further. The procedure for achieving this control is described in detail in a publication by McCuen.

The proper coordination of the functions of the ignition timing devices and the control of air-fuel ratio over the opening range of engine speeds and loads is further complicated by the knocking characteristics of the fuel itself. Octane number alone, although it is a convenience for purposes of marketing and manufacturing control, does not sufficiently define the knocking characteristics of a fuel at various engine conditions. In order to use fuel to best advantage the ignition timing and air-fuel ratio should be carefully tailored to fit a particular fuel. Since fuels may vary widely in respect to these characteristics, even though they may have the same octane number, the best the engineer can do is to make some kind of a compromise in his adjustment of ignition timing and air-fuel ratio. However, in the future I believe it is becoming increasingly important to study this aspect of the tailoring of engines to fuels in order to attain the optimum utilization of the very carefully manufactured fuels that we have today.

The availability of two grades of gasoline of reasonably uniform antiknock characteristics and volatility throughout the United States has been an important factor in the progress of automotive transportation.

In a steadily rising octane market advances in engine design have been based on the availability of a premium gasoline. However, in too many cases I am afraid we have been using the full octane value of the premium gasoline only a small fraction of the total operating time where it has served as a cushion against variations in ignition timing, combustion-chamber deposits, and other factors from one car to another. At present levels of octane number we can ill afford not to make the best possible use of the fuel.

Thus far we have used a comparatively simple ignition timing mechanism to perform a rather complex control function. I think we should examine our present procedures to determine whether a more perfect control would give us a significant gain in fuel economy and whether such a control would be worth the added cost and complication in servicing.

Table 1—Carbon Monoxide and Air-Fuel Ratios Determined from Exhaust Gas Analyses for Twelve 1957 Cars of a Single Make

Car	Idle		Road Load					
			20 Mph		40 Mph		60 Mph	
	CO	*A/F*	CO	*A/F*	CO	*A/F*	CO	*A/F*
A	3.1	13.6	3.0	13.6	1.4	14.7	1.0	15.3
B	7.0	11.8	6.8	11.8	1.2	14.4	1.4	14.3
C	7.7	11.9	6.7	12.2	1.4	14.2	1.4	14.3
D	7.0	11.9	7.6	11.6	2.0	13.7	2.3	13.5
E	8.9	11.3	8.6	11.4	1.5	14.1	1.5	13.9
F	8.3	11.4	6.7	12.1	1.9	13.7	1.7	13.8
G	5.6	12.3	5.3	12.4	1.0	14.5	1.3	13.8
H	6.2	12.0	5.5	12.4	1.0	15.6	0.5	15.2
I	8.3	11.5	8.4	11.3	1.3	14.6	1.5	14.4
J	7.4	11.9	6.4	12.2	0.6	16.0	0.7	15.8
K	9.8	11.0	8.1	11.8	4.3	13.2	5.2	12.9
L	5.2	12.8	2.1	14.0	1.1	14.8	1.0	14.7

Improvements in Control of Carburetion Needed

In addition to the influence of fuel losses on air pollution, I have often been concerned with the variation in air-fuel ratio between one car and another of the same make and model within present limits of production control from the standpoint of fuel consumption.

For example, Table 1 shows the carbon monoxide and air-fuel ratio determined from exhaust gas analysis for twelve 1957 cars of a single make. Air-fuel ratio (*A/F*) is expressed as pounds of air per pound of fuel as determined from exhaust gas analysis.

Duplicate samples were taken at each point and the figures shown in the table are the average of the analyses on the two samples.

All of these cars were in normal customer service and functioning satisfactorily as far as their owners were concerned. And yet at 40 and at 60 mph there was a difference of almost 3.0 air-fuel ratios between the richest and the leanest of these 12 cars. This corresponds to a difference of almost 20% in fuel consumption between the richest and the leanest carburetor.

Just to show that this is not an isolated case, I have included data on seven units of another make of 1957 car selected at random and treated in the same manner in Table 2.

Here there was a difference of 5–6 air-fuel ratios between extremes. This corresponds to a difference

Table 2—Carbon Monoxide and Air-Fuel Ratios Determined from Exhaust Gas Analyses for Seven 1957 Cars of a Certain Make

Car	Idle		Road Load					
			20 Mph		40 Mph		60 Mph	
	CO	A/F	CO	A/F	CO	A/F	CO	A/F
A	7.0	12.2	3.5	13.6	1.1	14.7	0.2	16.8
B	5.5	12.7	4.1	13.2	5.0	12.8	2.3	13.8
C	2.7	13.5	1.5	14.3	1.9	13.9	0.3	15.5
D	8.2	11.7	4.0	13.3	2.9	13.7	2.3	13.9
E	7.0	12.2	1.3	14.4	2.1	14.1	1.1	14.5
F	6.9	12.1	8.6	11.4	13.9	9.5	12.0	10.2
G	6.2	12.5	2.9	13.8	1.4	14.3	0.9	14.9

of 35–40% in fuel consumption at 40 and 60 mph. It is obvious from these data that there was something wrong with car F but the difficulty was not apparent to the owner. Within the limits of inflammability a wide variation is possible without the driver's knowledge of any symptoms of malfunction.

However, if we could operate all our cars as lean as the leanest ones are running in these tables we might be able to gain as much as 5% in overall fuel economy. To the average driver this could mean 400–500 miles of free transportation annually. Built into the national economy this could result in a substantial saving in the annual gasoline bill.

Looking Forward

The internal-combustion engine has been a great boon to the welfare of mankind. Endowed with a plentiful supply of crude oil from which we have produced an energy-rich fuel in the form of gasoline, and supplied with a nationwide network for distributing this energy as required, this country has undergone an economic transformation as a result of low-cost and universally available automotive transportation.

Automotive transportation in all its forms—automobiles, trucks, buses—and all its contributory activities, together have contributed immeasurably to the economic well-being of this country. No civilization has ever approached such a high level among all its members and I would give the automotive transportation and related industries a large measure of credit for this accomplishment.

There is every indication that the desire for individualized transportation is universal, indeed it is today a necessity. It has given Man a new freedom—the freedom to go from one place to another at any time. Its growth is limited only by the availability of suitable highways, parking facilities, population, and finally by a plentiful source of energy to make it go.

As a power industry the automotive transportation industry and the petroleum industry together represent by far the largest power industry in the world—over 8 billion horsepower in mobile packaged power with a power outlet at every filling station.

In looking forward I believe that fundamentally a fuel of predominantly hydrocarbon composition will continue to be most suitable for automotive power. Although our raw materials for producing gasoline such as crude oil, gas, tar sands, coal, and lignite, appear adequate for many years to come, the demands for energy for all uses are rapidly climbing upward and as power engineers we have an economic responsibility to burn all our fuels as efficiently as we know how in order to produce the total power that is dictated by the times. Much remains to be done in fitting engines and fuels together more effectively and within the boundaries of sound economics. Certain modifications of the hydrocarbon structure and boiling range make it possible to use fuels more effectively. But the really big problem is production of the huge quantities of gasoline manufactured to the very close tolerances that are required of motor gasoline for universal use throughout the country.

The automotive engineer, on his part, will need to take greater care in controlling mixture ratio, ignition timing, and other factors including uniformity of the product, in order to build into the engines the maximum efficiency of fuel utilization. The problem is made difficult by the fact that automotive power is so widely distributed, necessitating careful control and servicing of millions of individual powerplants.

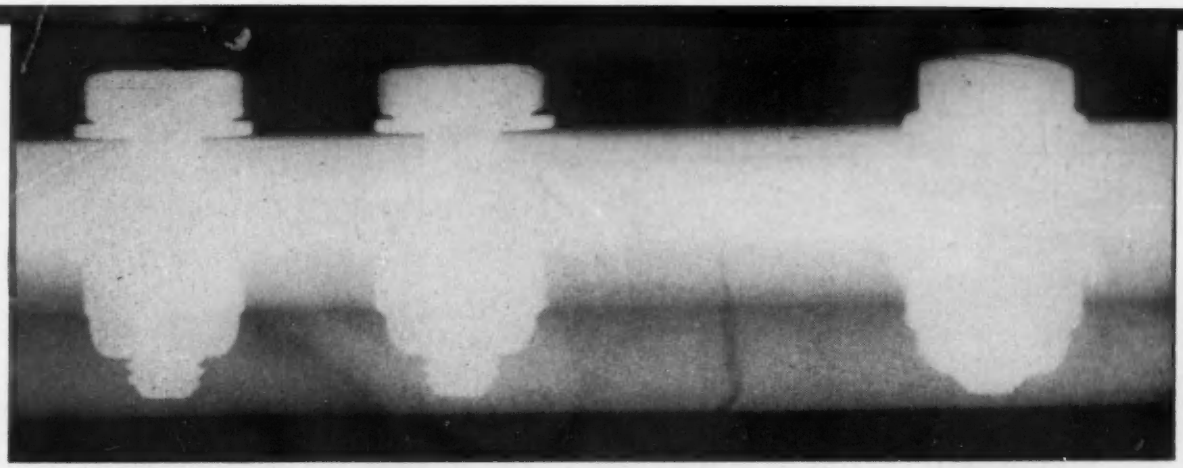
Because we are dealing with such large amounts of fuel, a gain of only 6% in total annual fuel consumption through improved efficiency could be worth as much as a billion dollars to the consumer —an amount comparable to the total fuel bill of the electric utility industry.

Looking to the future, we need to devote our best efforts to the discovery of entirely new processes of energy conversion. In order to conserve our reserves of fossil fuels we need improved processes for converting chemical energy into mechanical or electrical energy. The best of our present heat engines waste far more energy than is converted into mechanical power. It is hoped that some entirely new principle of energy conversion will be discovered. We have some encouragement from our knowledge of electrochemical and thermoelectric processes, although none of these as yet would be competitive with our present heat engine for automotive transportation.

Finally, in preparation for the time when our fuel reserves begin to run low, we must have ready some means of utilizing either solar energy or nuclear energy on a large scale. Even here the basic processes of energy conversion from heat and radiation to electrical and mechanical power are of no less fundamental importance.

Meanwhile, it will continue to be one of our most important jobs to make the best possible use of that most remarkable form of packaged power that we know as gasoline, and this, indeed, is the objective of the Horning Award.

To Order SP No. 216 . . .
. . . on which this article is based, turn to page 5.



A CRACK in the wing stringer in the fuel tank of a DC-6 is found on the X-ray photograph. Typical exposure time for photographing is one minute. Complete X-ray inspection for a DC-6 or DC-7 is about four hours. No special lead shielding is needed, provided personnel is kept clear of the immediate area.

How Airlines Use X-Rays

Diffraction and conventional X-ray photographs are used to detect stresses and cracks in the DC-6, DC-7, DC-7B, Convair 340, and 440 airplanes

Based on paper by

A. D. Edwards

Delta Air Lines, Inc.

HARD-to-find cracks and overstressed parts are detected by two X-ray techniques in the Delta Air Lines maintenance program. Cracks are exposed by shooting through the part, similar to a dental X-ray of teeth. Residual stresses are found by the diffraction pattern caused by non-uniform spacing in the crystalline structure of the metal.

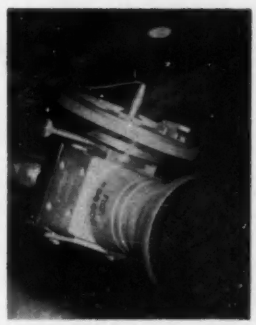
Spar tangs, fuselage and outboard-nacelle hardware, door frames, and stringers are among the parts checked for cracks by photos. Faults are found without extensive removal of trim or covers.

Diffraction photographs can be used to show overheated conditions and fatigue as well as residual stress. Fatigue is determined by photographing the diffraction pattern at a critical point over several overhauls. A change in the pattern can indicate growing fatigue.

Delta Air Lines entered its X-ray program when it found equipment that was light and small enough to handle on a maintenance line. A 160- and a 175-kv machine are now being used. Approximately 1000 w of 110, 220, or 440 a-c current is needed to power the X-rays. In addition an "Androscope" is used for diffraction pictures. This unit is small but requires water cooling.

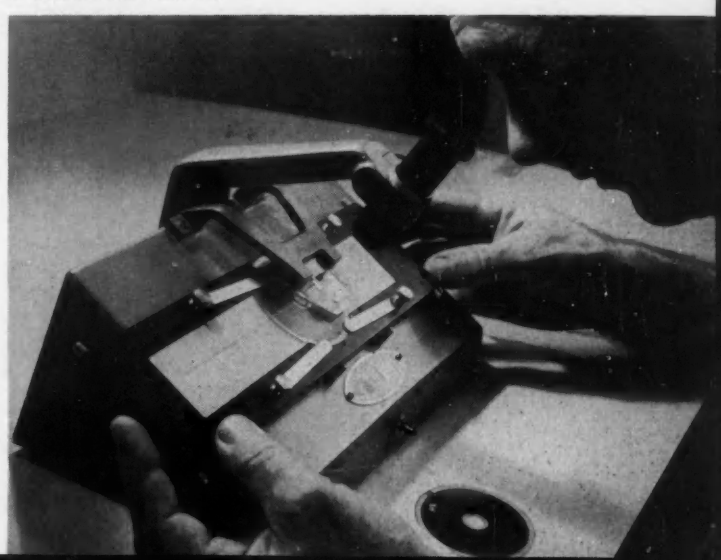
Photographs of variable thickness parts require high- and low-speed film over the parts. A "one-shot" X-ray will then detail the whole part. One combination is Kodak "AA" and Ilford "C" films.

To Order Paper No. 223 . . .
. . . on which this article is based, turn to page 5.



THE HEAD of the diffraction X-ray machine is pointed at a cleaned spot on the spar cap of a DC-7. A circular film is exposed in two 180-deg sections. A nonstressed part will show a circular pattern for a 45-deg angle between part and film. Stressed parts give an oval pattern. Pictures are taken in sections so the flattening of the circle, typically on one side, will be emphasized. The X-rays are projected through a hole in the center of the film and reflected back to the film from the part.

MEASUREMENTS of the offset of the two halves of the diffraction photograph are made on a reader. From the offset values the actual stress in psi can be calculated. Such a residual stress might be due to shotpeening, cold rolling, twisting, or bending beyond the yield. Applied stresses are also measured.



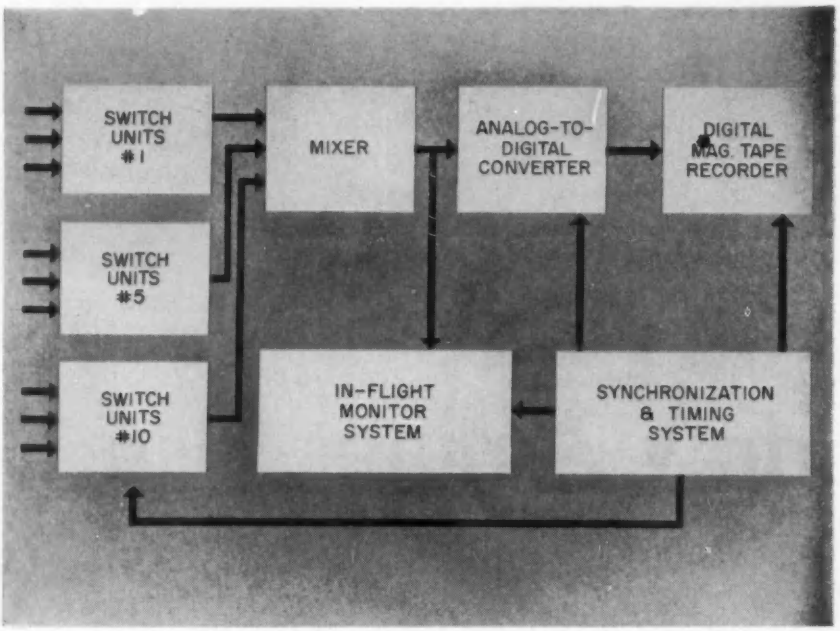


Fig. 1—Low-frequency (digital) data collection system permits hundreds of temperatures and pressures to be recorded once a second during flight testing and converted to digital form right in the airplane.

Speed and low cost will feature . . .

New System for Handling

Based on paper by

H. W. Royce

Martin Co.

A DIGITAL data processing system has been designed to handle a portion of the flight test data required to evaluate and demonstrate the Martin YP6M-1 Seamaster. It will record the slowly changing data on quasi-static measurements right in the airplane and it is capable of sampling up to 1000 measurements once each per second.

Data Collection System

A diagram of the data collection system is shown in Fig. 1. On the left are the input signal leads from up to 1000 transducers feeding into 10 switch boxes. Each switch box is capable of switching the signals from 100 transducers through one of the 10 amplifiers. The outputs of the amplifiers are then gated sequentially to a mixing stage and thence into the analog to digital converter of the successive approximation type. The amplifiers, mixer, and analog to digital converter are being designed and built by Hoover Electronics.

The output of the analog to digital converter is then fed in 11 bit parallel binary form to the 14-channel magnetic tape recorder. This recorder is being designed by the Consolidated Electrodynamic Corp. and is very similar to that company's standard Datatype system with the exception of the reel size, which is 10½ in. instead of 9½ in., and the use of a set of digital transistorized amplifiers in place of normal analog amplifiers.

The entire airborne unit is controlled by a central synchronizing and timing system. The synchronizer uses beam switching tubes to generate pulses which are sent to the relays in sequence. The synchronizer provides the gating pulses for the amplifiers as well as the sampling signals to the analog to digital converter.

An in-flight monitor system gives the flight engineer the option of selecting any 10 of the 1000 signals for presentation on visual indicators, which are being produced by the Greenleaf Mfg. Co.

Data are arranged on the 14 tracks of tape as follows: 10 tracks are used for the data, one track is used for the algebraic sign, one contains a parity check bit, one contains frame and elapsed time signals in the form of the 10-sec Patrick Air Force Base slow code, while the 14th track contains sprocket pulses.

To aid in processing the data on the ground and in coordinating these data with other information collected both in the air and on the ground, we record in digital form, at the start of each test, one frame of identification data covering aircraft model number and serial number, flight number, and date. Military time will be derived from a unit operating essentially as a binary clock. Before take-off, this clock will be preset to the exact military time and from that point on will continue to generate time,

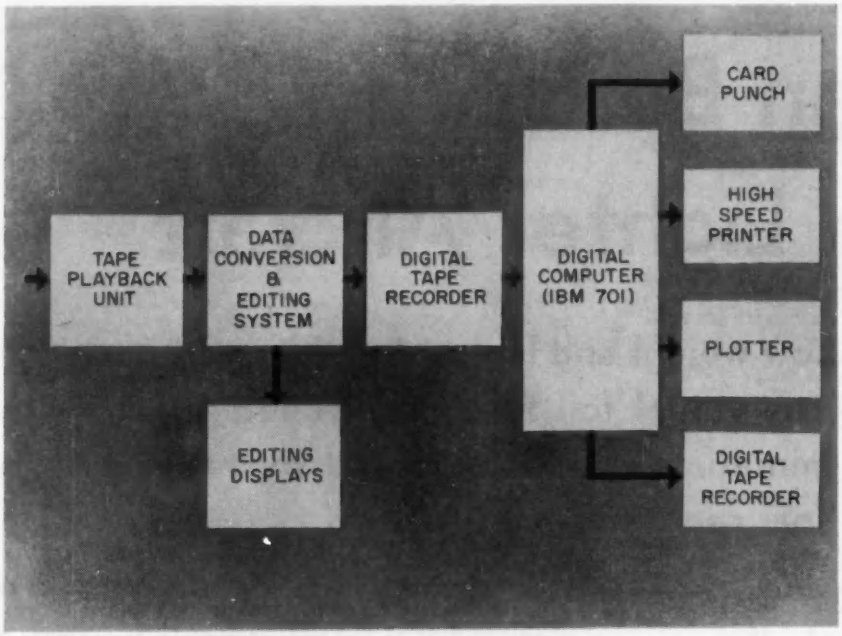


Fig. 2—When airplane has landed, flight test data are processed at high speed using this system.

Flight Test Data

using pulses generated within the synchronizing and timing system. These data will be recorded as one additional identification item in hours, minutes, seconds, and tenths of a second.

Data Processing System

At flight termination, the magnetic tape will be removed from the airplane and taken to the data reduction center where it will be played back through the data conversion and editing system, as shown in Fig. 2. The system provides for selection of any 12 of the 1000 signals for presentation on a fixed styli tape recorder. At this point, the flight engineer using the test program notes will advise the data reduction personnel which signals he wishes to have played out on a real time visual display for use in editing each of the runs. The data which are recorded at a tape speed of 4 in. per sec during the flight are played back at a speed of 60 in. per sec, thus generation of the editing display for a 3-hr flight may be accomplished in less than 15 min. By proper selection of the editing signals the flight crew can determine which portions of the data are of sufficient interest to warrant further data reduction.

Once the editing instructions have been completed, the airborne tape is again played through the equipment, this time at 20 in. per sec. The editing instructions are used to program the desired data through the conversion portion of the system which changes the data from the straight parallel binary form to the format suitable for recording on IBM 727 tape machines. The two IBM 727 tape transports are required for the generation of the ¾-in. gap required for starting and stopping these transports when data are being fed into either the IBM 701 or 704 computer. The alternative was to use a cyclic binary storage system, which turned out to be more expensive than renting the two tape transports.

Calibration data on each of the instruments will be collected on IBM cards before flight to prepare the data for processing through the IBM computer. The calibration data together with programming instructions will be inserted into the IBM 701 ahead of the data. This computer will then be used for sorting out the measurements, since reading No. 1 on measurement No. 1 will be located 1000 words away from reading No. 2 on measurement No. 1. Once the data are sorted the computer will apply the calibration and scale factor corrections and perform any additional computations required on the data. The data will then be recorded fully corrected and computed on another IBM 727 tape. Then this tape may be used for operating a high-speed printer or plotter for presenting the data to the flight personnel and design engineers.

To Order Paper No. 192 . . .
. . . on which this article is based, turn to page 5.

Steel Can Be Used To Produce Lighter Aircraft

Low weight and high strength are achieved by using steel foil that is stiffened locally with miniature corrugations and by tapering the spar caps to match the load.

Based on paper by

Bruce Mitchell

Ryan Aeronautical Co.

STEEL can compete with aluminum and titanium for airframes. Making full use of its strength and availability in thin sheets offsets the theoretical advantages of the lighter metals.

One of the better steels for light-weight aircraft structure is 17-7PH. It is particularly desirable for thin-sheet applications because it can be heat-treated without scaling. It is annealed at 1750 F to prepare it for transformation at low temperatures. The annealed material has a yield strength of 45,000 psi and elongation of 35%. It is transformed at −100 F after which it has a room temperature yield strength of 110,000 psi. The final aging treatment is given at 950 F. The steel then has a room temperature yield strength of 200,000 psi and an ultimate tensile strength of 240,000 psi, with elongation of 5%.

Fig. 1 compares 17-7PH steel, on a strength, weight, and temperature basis, with 6AL-4V titanium alloy, 75ST aluminum alloy, and HK31XA magnesium alloy. The comparison is made with compression yield stress as a limit because that represents the major design limitation. The diagonal lines on the chart cross the vertical lines at points of equal weight.

Fig. 1 shows a required yield strength of 250,000 psi if the steel is to match the strength-to-weight value of the titanium alloy at room temperature. This strength-to-weight advantage of titanium alloy diminishes as the temperature increases. Note that at 700 F, where the steel has a yield stress of 160,000 psi, the strength-to-weight ratios are approximately equal. In addition, much of the theoretical advantage of the titanium alloy at room temperature is lost because of practical considerations. For example, titanium alloy is unavailable in sheets thinner than 0.025 in., is not easily welded or formed, and is initially a very expensive material.

The theoretical strength-to-weight advantage of steel over aluminum and magnesium at room temperature and at elevated temperatures becomes a practical advantage if the full available strength of the steel is used. The room temperature yield strength of 17-7PH steel is 200,000 psi, which means that a piece of this steel 1 in. wide and 0.001 in. thick can carry an axial load of 200 lb. To exploit this high strength, however, requires stabilizing the sheet for compression loads of this magnitude or collecting the load and concentrating the material until stabilization is possible.

Tests indicate that the buckling formula:

$$F_c = KE\left(\frac{t}{b}\right)^2$$

where:

F_c = Buckling stress
E = Modulus of elasticity
t = Skin thickness
b = Panel width
K = Empirical constant

holds true for thicknesses at least as low as 0.002 in.

Fig. 2 is a plot of the allowable buckling stress of steel panels with a K factor of 3.6. The plot indicates a required stiffener spacing of 0.50 in. for 0.022 in. skin or 0.10 in. for 0.0045 in. skin to prevent buckling at a stress of 200,000 psi. Practical considerations, however, prevent the use of individual stiffeners that are spaced closer than 0.375 in. This restriction led to the consideration of miniature corrugations as a practical means of obtaining closely spaced stiffeners.

Design of Structure

The structural design of the complete airplane should follow a smooth pattern of gradual transition from lightly loaded structure to high load structure. Excesss material must be avoided wherever possible with strength and stiffness as the sole reason for putting it in.

Miniature corrugations when welded to thin skin can provide a very rigid surface covering for the airplane. This combination is rigid in one direction only and locally very strong. The corrugations are too shallow, however, to have good column characteristics. It is not practical, usually, to provide enough supports to get the column length down to the short column needed for high stress. This corrugation-skin combination has good bending stiffness in one direction and can be used effectively to beam the pressure loads to the spars.

To use high strength steel efficiently, the stiffened foil construction must be carried into all of the supporting structure. This can be demonstrated by looking at a typical spar shown in Figs. 3 and 4. At the spar tip the shear load is practically nil and the bending moment is zero. The shear web will start as a corrugation made from 0.001 in. gage metal. It is fixed to the spar cap by two attach angles for stability. As we follow it inboard the shear load increases forcing an increase in the corrugation gage or the addition of a sheet, or both, as shown in Fig. 3. A further increase in shear may require the second sheet shown in Fig. 4, and for extremely high shear loads the corrugation may give way to individual stiffeners.

Similarly, the spar cap may be the doubler corrugation plus the skin and skin corrugations. As the moment builds up the axial load will increase to a point where the beam cap shown in Fig. 3 becomes necessary. This beam cap can start at about 0.004 in. thick and 0.50 in. wide and increase in thickness and width as the load requires. This cap is well stabilized and can work at a stress of 200,000 psi.

There are cases where there may be a relatively low shear load and a high bending moment. Here the beam deflection will create a compressive load in the shear web that must be accounted for. The caps may be curved geometrically and require additional stiffening in the shear web to offset the directional change of the cap load. In addition, there is a stabilizing force which must be taken into account. This stabilizing force is given by the empirical curve of Fig. 5, where the spar cap is considered to be made up of a series of short columns whose length is determined by the radius of gyration of the cap and the column stress in the cap. This stabilizing pressure alternates in direction from one node of the column to the next. It is given as a pressure because it is a uniform force across the full width of the cap. At a cap stress of 195,000 psi this stabilizing pressure is 100 psi and is critical only for the attachment and buckling of very thin webs. A narrow cap width will reduce this pressure and is recommended where the strength of the attachment of the web to the cap may be critical.

This type of structure is readily adaptable to integral fuel tanks. Seam welds or overlapping spots make a fuel-tight joint. Multiple spar construction will keep the tension loads on the spots within safe limits and final closure of the tank can be made by external fusion welding.

In deep beams with low shear loads it is more economical to use a built-up truss rather than full-depth webs. This follows the basic design principle of gathering the light loads into enough concentration to use the full strength of the material.

Assembly of structure built up from sheet has not

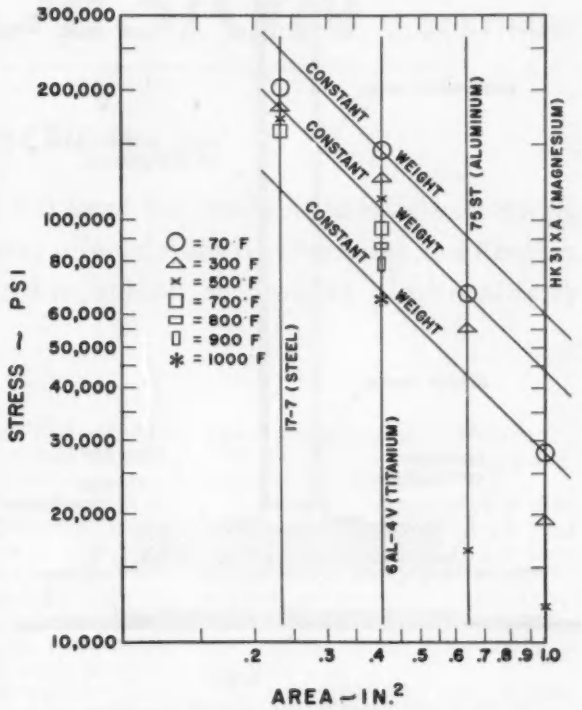


Fig. 1—Compression yield, strength-to-weight comparison of 17-7PH steel, 6AL-4V titanium alloy, 75ST aluminum alloy, and HK31XA magnesium alloy for elevated temperatures. The diagonal lines cross the vertical lines at points of equal weight.

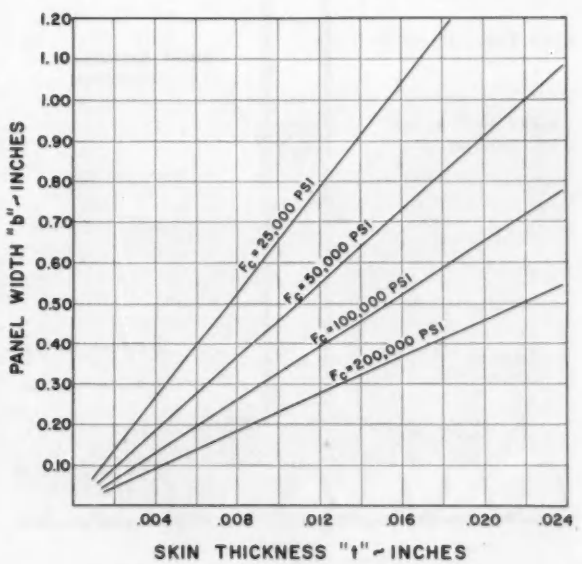


Fig. 2—Buckling stress for steel panels.

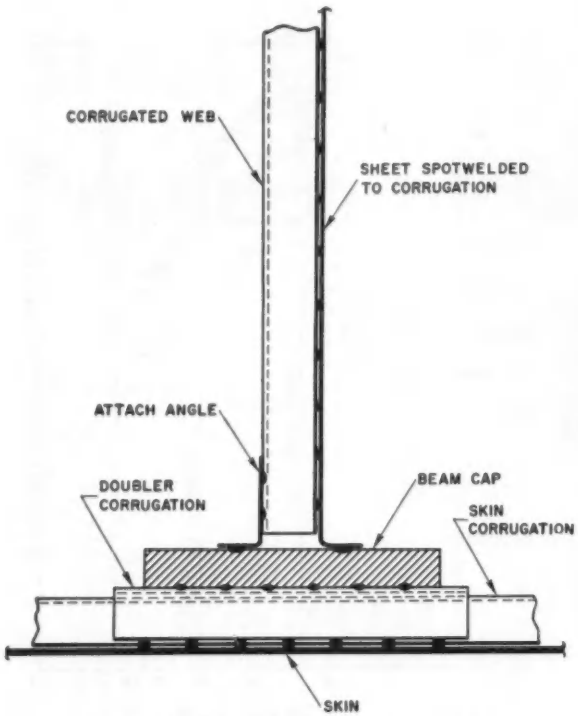


Fig. 3—Attachment for beam across the corrugation.

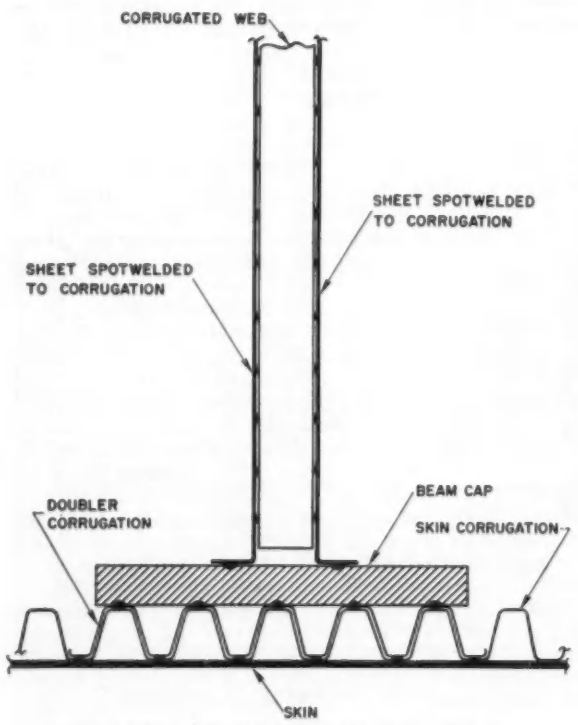


Fig. 4—Attachment for beam parallel to corrugation.

presented serious difficulties even though the gages range from 0.001 to 1.0 in. These assemblies are easily built up from smaller subassemblies with the only limitation on size being accessibility for welding. Production spot welding of the corrugation to the skin can be done with multiple welding units with a roller running in each corrugation.

We have not tried to anticipate or solve all of the problems that may be encountered in designing and building with high strength steel foil. These problems are better handled on specific designs than as general solutions. There is no good way of making a weight comparison between this type of design and the more conventional skin-stringer or honeycomb design, except by comparing direct calculations of the total material used in comparable designs intended for the same purpose. The designer can be sure his weight is a minimum if he has achieved a taper effect in material that matches the applied load for his primary structure and if his supporting structure contains the least possible material needed to prevent buckling of the primary load members. He must also use a material with a high strength to weight ratio and be able to develop stresses near the yield strength of the material.

To Order Paper No. 210 . . .
. . . on which this article is based, turn to page 5.

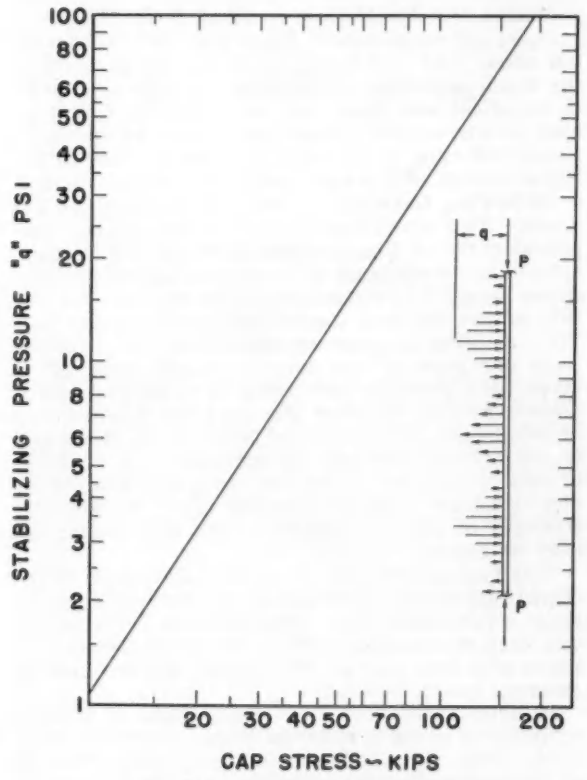


Fig. 5—Compression cap stabilizing force.

1958 CAR DESIGN ... CONTINUED

Continued from page 29

breathing. A new camshaft is used in the 1958 models. Cadillac is offering a 335-hp and a 310-hp engine for 1958. Displacement is 365 cu in.

Chevrolet's new Turbo-Thrust 348 cu in. engine has improved cooling, a new exhaust system with resonators as well as mufflers, and better ventilation. The top face of each cylinder block is inclined at 16 deg rather than machined perpendicular to the bore. Cast-aluminum pistons are similarly angled with 16-deg sloping surfaces. The combustion chamber is entirely within the block instead of extending into a domed indentation in the head. This permits placement of inlet and exhaust valves more advantageously, according to Chevrolet engineers. Compression ratio is 9.5/1.

Studebaker - Packard's engines for 1958 include the Sweepstakes Six with 185.6 cu in. (used on the Scotsman and Champion series) and V-8 engines ranging from 180 to 275 hp with supercharger. Two-barrel carburetors are specified on the Commander and Silver Hawk, 4-barrel units are used on the President series. A supercharger is standard equipment on the Golden Hawk.

Fuel Injection . . .

. . . introduced last year, has made little headway during 1957 but is being offered again by Chevrolet and Pontiac. Chrysler's fuel-injection system is electronically controlled.

THE new Chrysler fuel-injection system uses electrical impulses to meter fuel instead of a mechanical metering device. Heart of the system is an "electronic brain" box, which houses a transistor-equipped electronic modulator.

When the engine is running, the electronic modulator, located in front of the radiator, receives signals from sensory units mounted in and around the engine. These signals report engine temperature, throttle position, air temperature, engine load, and altitude. The "brain" immediately translates these into fuel requirements for the engine. According to the information received, the "brain" lengthens or shortens an electrical impulse. A signal is then sent out to open the injector valves. Valves are designed to stay open only 1.0–4.3 thousandths of a second.

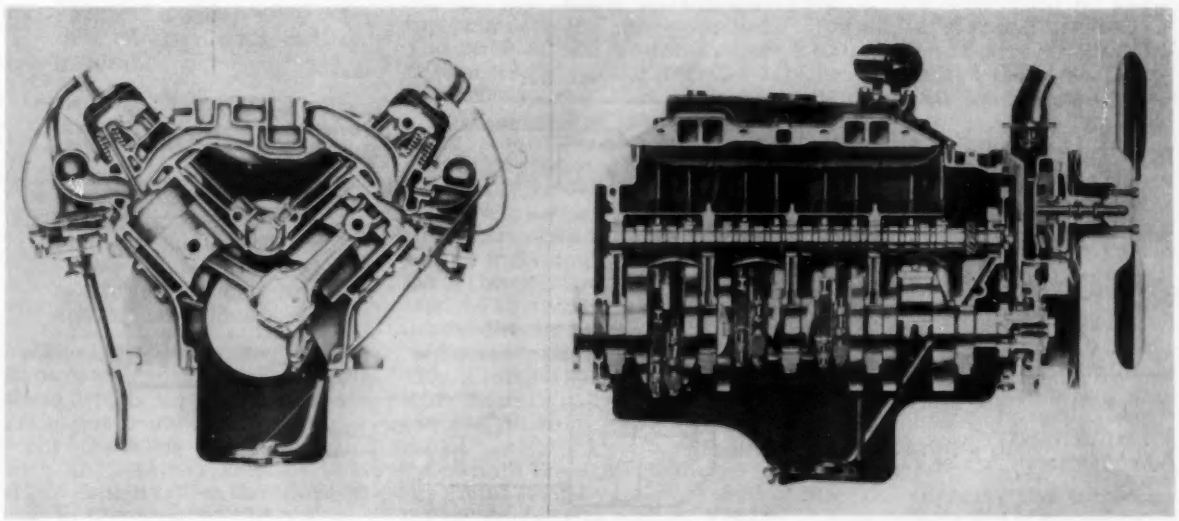
Fuel is injected with each power stroke of the pistons.

An electric, motor-driven fuel pump, submerged in the gasoline tank, pumps fuel into pipelines which travel along the top of the engine, serving both banks of cylinders. The fuel pump motor does not operate unless the engine is running.

An extremely fine filter is used to trap dirt or metal that might get into the fuel line. There is also a magnetized wire spring in the pressure-regulator filter, which catches minute metal particles.

According to Chrysler engineers, fuel-injection laboratory and road tests show extremely fast warmup and increased fuel economy.

CONTINUED ON NEXT PAGE



CHRYSLER'S NEW V-8 engines have (left) newly designed combustion chambers and manifolding and (right) new deep skirt block and rigid crankshaft and camshaft.

Exhaust Systems . . .

. . . have been revised to avoid stains on bumpers, accommodate air suspensions, and reduce exhaust noises.

THE outlet on the 1958 Buick has been styled to exhaust below the bottom level of the rear bumper face plate. Exhaust outlets are not visible but bumper discoloration should be reduced.

To accommodate its air suspension, Buick's tailpipe hanger has been redesigned at the kickup location. This also assures proper clearance between the tailpipe and air-suspension components.

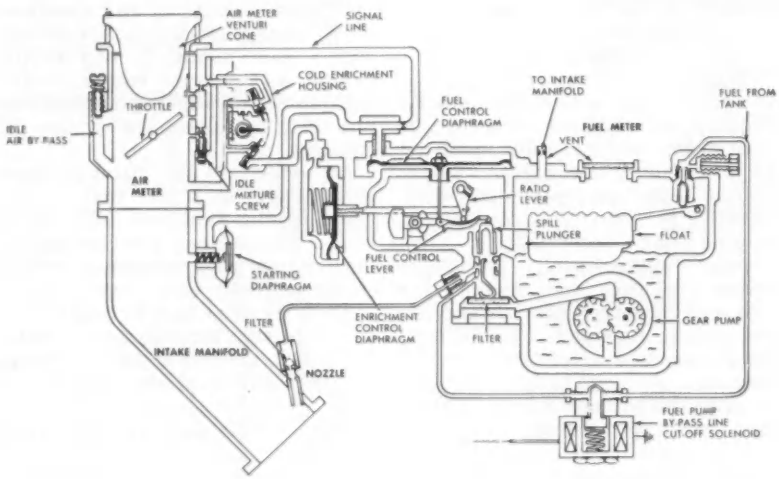
Both dual and single systems again use ball-joint connectors for joining exhaust system components.

Pontiac has a new exhaust system, including a new muffler and a 2-section tailpipe. Resonators have been added on the dual exhaust system. Each resonator is mounted behind the rear axle and is tuned with the muffler to give maximum reduction of exhaust noises. Gases are expelled below the rear bumper.

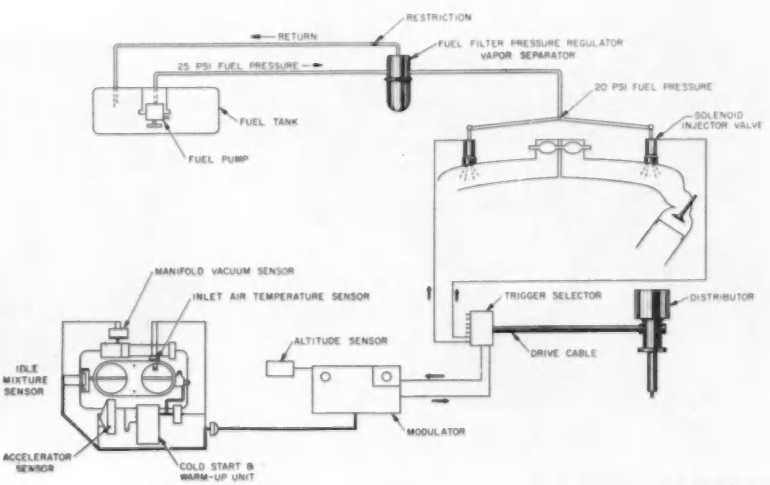
Larger diameter Y-type inlet pipes on V-8's and larger mufflers on all models except two give Ford a more efficient exhaust system. Resonators are installed on Sunliner and Skyliner models with dual exhausts.

Both heads and the inner shell on all mufflers are zinc coated. All Ford mufflers have double-wall or shell construction, with an extra wrapper around the body of V-8 mufflers for increased quietness.

A new configuration helps Chevrolet's engine breathing. Upon leaving the engine, gases are forced downward. Freedom from drastic bends reduces back pressure.



PONTIAC fuel-injection system shown schematically.



INJECTION TIMING and injector actuating elements of Chrysler's fuel-injection system showing paths of various signals for fuel requirements to electronic "brain" or modulator. Electric pulses are lengthened or shortened by "brain," which opens injector valves for precise metering of just the right amount of fuel into cylinders. Offered as optional equipment on Plymouth models using 350 cu in. Golden Commando engine, on Dodge models with 361 cu in. D-500 engine, on De Soto Adventurer, and Chrysler 300-D.

Cooling Keeps Pace . . .

. . . with bigger engines, increased horsepower, and the growth of air conditioning, with the help of larger radiators, better flow control, and automatic cooling fans.

THREE-stage cooling is Ford's answer to faster engine warmup. As soon as the heads and the intake manifold are at desired temperature, water is allowed to circulate in the block. Thermostats open at 140 F, to permit this second-stage circulation.

The third thermostat, located at the intake manifold, opens at approximately 160 F; water then flows through the radiator core, back to the heads, intake manifold jacket, and block, opening up the complete circulation system. Advantages of the method: improved engine warmup and faster heater warmup.

Buick has increased its radiator width from 21.9 in. to 25.2 in. A full shroud replaces the ring-type used in 1957, providing more efficient air movement through the radiator at low speeds and idle. A torque-limited fan drive is provided on all air conditioned cars. Increased radiator capacity is expected to be helpful in some local areas, particularly in the southwest or where passenger cars are hauling heavy loads such as trailers.

More uniform cooling of Chevrolet engines is assured by locating water pump outlets at the outer jackets of the cylinder block. Outlets are positioned so the coolant may flow freely around each bore and then into the cylinder head.

Buick's new fan drive for air conditioned cars operates on the torque limiting principle and has no external actuating elements. The fan is driven at input speed up to a given rpm as dictated by engine cooling requirements. Beyond this, the fan is not driven faster, regardless of increased engine speed. This arrangement saves power and reduces fan noise.

Transmissions and Drive Controls . . .

. . . have been changed. Buick's new Flight Pitch Dynaflow and Edsel's Teletouch Selector attract attention. Auto-Pilot offers new method of speed control.

THREE significant developments in transmissions and controls have been announced:

- Buick's new Flight Pitch Dynaflow eliminates the need for a low-range position on the driver control quadrant.
- Edsel is the first to offer pushbutton control on the steering column.
- With its 1958 models, Chrysler introduced an Auto-Pilot system, a device providing automatic speed control under most normal driving conditions.

The 1958 Buick Flight Pitch Dynaflow transmission embodies three driving turbines in an automatic power-multiplying arrangement operating in conjunction with an infinitely variable pitch stator, which tailors the transmission to the needs of the engine.

Inside the rim of the multiple-pitch stator, 20 blades automatically take the right position for every performance demand, adjusting themselves automatically to the throttle position. For normal city driving, the blades operate at "low" angle for optimum fuel economy and minimum rpm. The pitch of the blades changes automatically as the throttle is opened or closed.

There is no "low" position, since these requirements can now be met in the driving range.

Flight Pitch Dynaflow has three turbines in a new 5-element torque converter. Two turbines are connected individually to the output shaft through two planetary gearsets. The third turbine is connected directly to the output shaft.

Maximum starting ratio is 4.5/1. This is comparable to Buick's Variable Pitch Dynaflow when manually shifted from "low" to "drive" range.

Downhill braking is achieved in the Flight Pitch Dynaflow by shifting to "grade" (G) position. Both the engine and the transmission are used as braking forces. The G retarder clutch may be engaged at any speed up to 45 mph.

At all constant road speeds up to 70 mph the stator remains in "low" angle. Full-throttle position puts the blades in "high" angle. For part-throttle accelerations above 15-deg throttle opening, the blades shift into a position between "low" and "high," increasing part-throttle performance.

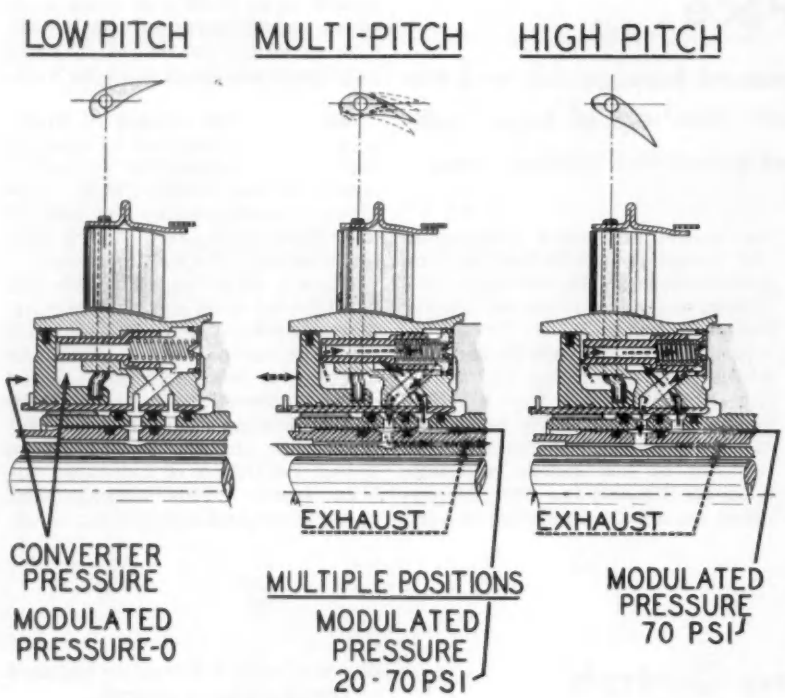
There are four friction-plate-type clutch assemblies; no band-type control elements are used.

The new selector quadrant sequence is P-R-N-D-G with G representing the grade-retard position.

(The new Buick Flight Pitch transmission will be described in detail at the SAE National Passenger-Car, Body, and Materials meeting in Detroit, March 4–6, 1958.)

The new Edsel has an interesting selector mechanism. Called Teletouch Electric Pushbutton Transmission Selector, the device is mounted in the center of the steering wheel hub. Pressing a button makes an electrical contact, activating a relay. This relay causes the actuating motor to function, engaging the transmission in the selected position.

The Teletouch selector has several safety features. When the



BUICK FLIGHT-PITCH DYNAFLOW transmission with multipitch stator.

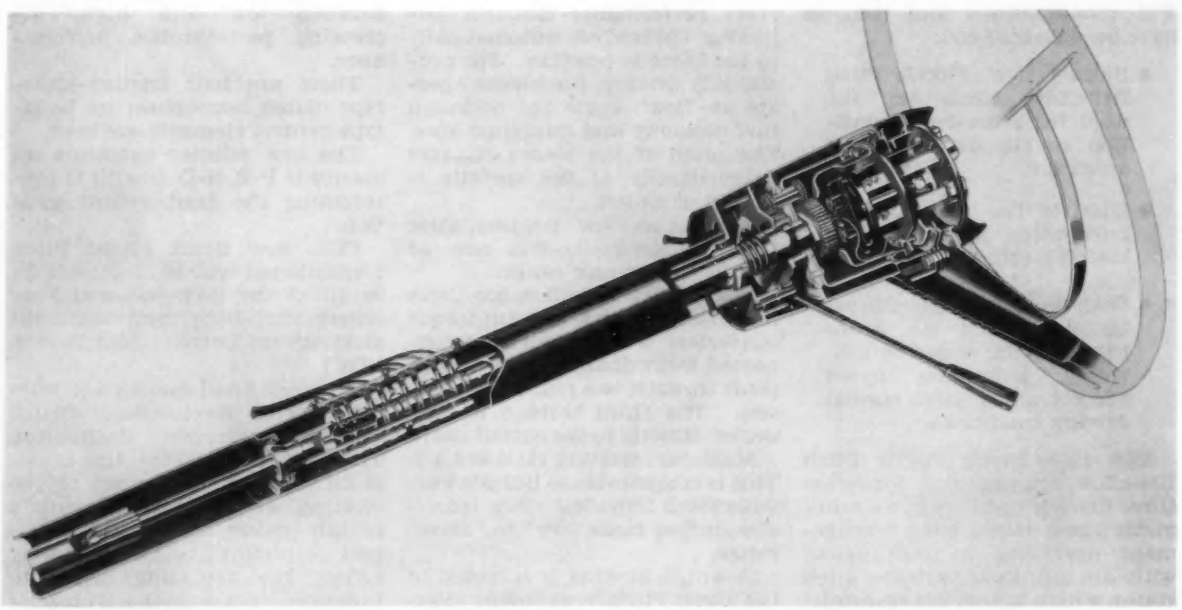
ignition is off, the transmission can be shifted to "park" position. However, "park" position cannot be changed until the ignition is turned on. The car may be started, of course, on an incline with the selector in the "park" position, without fear of rolling.

A dual inhibitor switch prevents the transmission from engaging in reverse when the speed exceeds 3 mph (required for rocking the car in snow or mud). This switch also prevents engagement in "park" position above a safe speed.

Ford Motor Co.'s automatic transmission has had some interesting design changes. Many of the changes were made to adapt the unit to its higher torque engines.

The rear servo has been redesigned for smoother reverse engagement and smoother downshift from second to first gear.

A new control valve box provides the additional drive range. A one-way sprag-type clutch has been added. This replaces the action of disengaging the rear band and applying the front band with exact synchronization. The 1–2 (first to second) shift is said to be almost imperceptible. A new front-band servo assembly includes a hydraulic accumulator, which func-



EDSEL TELETOUCH electric pushbutton transmission selector is mounted in center of steering wheel hub. When desired button is pushed, it makes electrical contact, activating a relay. This relay causes actuating motor to function, thereby engaging transmission in selected position

tions as a cushion for front-band application. A 2-stage governor has been added for closed-throttle 3–2 downshifts.

With this versatile range transmission, a rear-axle ratio of less than 3/1 can be used.

Ford is offering a new water-cooled high-performance Cruise-O-Matic transmission as well as an improved Fordomatic unit. There is an aircooled version of the Fordomatic as well as a water-cooled unit for V-8 engines.

Chrysler is continuing its 3-speed TorqueFlite and its 2-speed Power Flite units. Both units have pushbutton control.

Hydra-Matic has undergone several changes to improve cold-weather operation. Two new automatic thermostats have been added, eliminating delayed upshifts during cold-weather operation. A new high-friction, neutral clutch facing material increases durability.

Other improvements include (1) increasing the torus cover neck and front oil seal diameter ⅛ in.; (2) replacing bronze thrust washers with needle thrust bearings; (3) increasing the capacity of the rear clutch unit accumulator; (4) redesigning the valve lands of the governor valves; (5) adding a flange to the torus cover to flywheel seal support.

Chrysler's new automatic pushbutton driving control is offered as optional equipment. The device, called Auto-Pilot, provides automatic throttle control, acts as a speed reminder, and enables the motorist to cruise on superhighways or expressways without exerting foot pressure on the accelerator.

The unit is installed in the engine compartment; the control is on the instrument panel. The unit links the accelerator and the speedometer together to provide automatic, semi-automatic, or conventional throttle control. After setting and bringing the car to the desired speed, the driver feels a warning back pressure from the accelerator. With the foot resting lightly against the pedal, the car will maintain this preset speed up hill and down. Auto-Pilot makes the throttle adjustments automatically.

If the driver wishes to pass, he overrides the pedal back pressure. As he again relaxes his foot, the car resumes the preset speed.

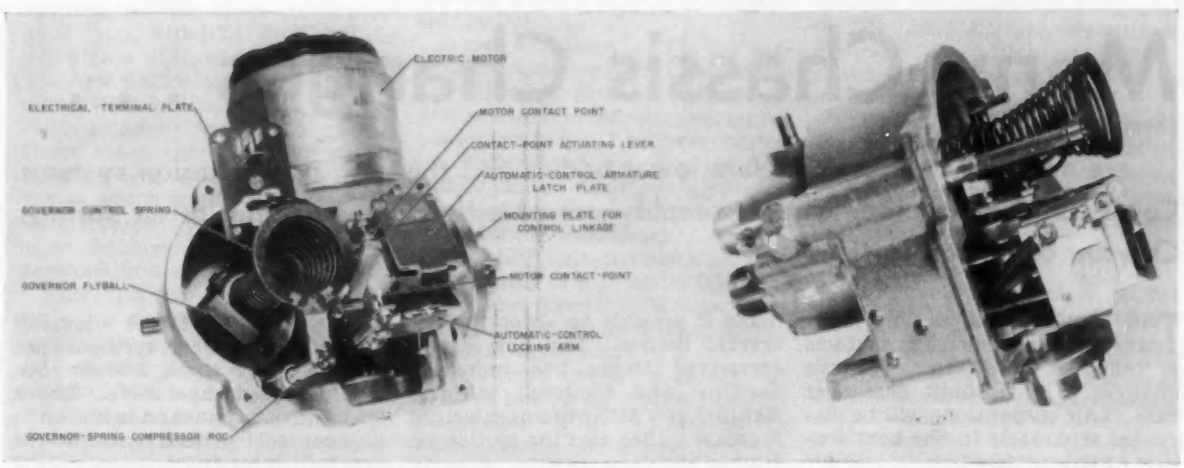
A small reversible electric motor activates the linkage to the accelerator and to the carburetor. Contact points for forward and reverse energizing of the motor are closed and opened by a flywheel governor under control of a helical governor spring, which is depressed or released to speed positions by a cable from the speed selector.

The automatic operation button recessed in the speed selector knob closes a circuit, which energizes an electromagnet. The electromagnet pulls down a latch, which couples accelerator and governor linkages. When the brake pedal is touched, the electromagnetic circuit is broken, the latch is released, and the accelerator pedal is released.



FORD CRUISE-O-MATIC transmission uses new sprag one-way clutch. This clutch, replacing action of disengaging rear band and applying front band with exacting synchronization, provides first-to-second upshift that is very smooth.

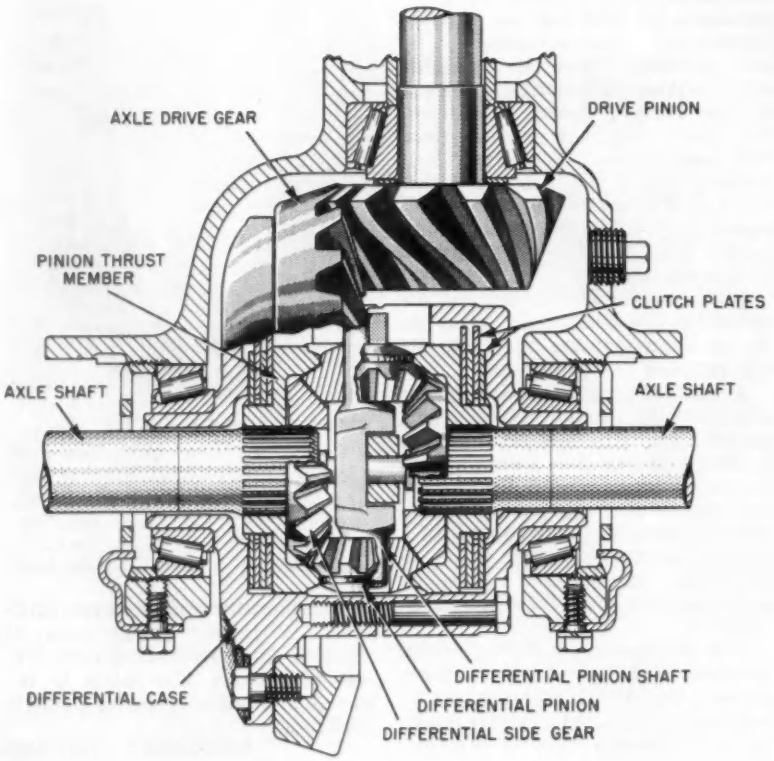
CONTINUED ON NEXT PAGE



CHRYSLER'S NEW AUTOMATIC PUSHBUTTON DRIVING control, called Auto-Pilot, provides automatic throttle control, acts as speed reminder, and enables the motorist to cruise without exerting foot pressure on accelerator.

Drive Lines and Rear Axles . . .

. . . have been changed in some cases, to accommodate lower bodies, increased power, and smaller wheels and tires.



INCLUDED in the items affected by body and engine changes are drive pinions, propeller shafts, and rear-axle ratios.

Some producers have increased drive pinion offsets. Two-joint, 3-piece propeller shafts are increasingly popular. Housings have been "beefed up."

Probably, the most significant change taking place in rear axles is the adoption of "limited-slip" differentials. Last year, two producers offered these new differentials as optional equipment; this year they are offered by practically all U. S. passenger-car producers.

The differential shown in the cutaway diagram directs extra pulling power to the rear wheel of the car having the most traction. The advantage here is in helping the driver to get out of snow, ice, mud, or gravel.

This newly designed gear is similar to a conventional differential with the exception of the addition of extra clutch plates. These tie the axle shafts to the differential case, so unused power in a spinning wheel is redirected to the wheel having solid footing.

SURE-GRIP differential is offered as optional equipment on Chrysler Corp. cars. It directs extra pulling power to car's rear wheel with most traction, thus aiding driving through snow, ice, mud, or loose gravel. Unit is similar to conventional differential, except for addition of clutch plates. These tie axle shafts to differential case, so that unused power in spinning wheel will be redirected to wheel with solid footing.

Many Chassis Changes . . .

. . . are necessary to accommodate lower bodies and the new air-suspension systems. Coil springs on all four wheels simplify use of either conventional or air springs. Chrysler continues Torsion-Aire.

THE combined impact of lower cars and air-suspension systems is reflected in sweeping chassis changes in U. S.-built passenger cars. (Air suspensions will be discussed separately in the next section of this article.)

A new tubular X-frame used by Pontiac and Chevrolet in 1958 has made it possible to lower the car several inches. The new cruciform-type frame has increased bending and torsional stiffness significantly with minimum weight increase. (See also the section on frames.)

For the first time in its history, Pontiac is using coil springs on all four wheels. A larger diameter and longer front coil spring is used to provide low stress, a lower rate, and increased wheel travel. Shock absorbers are new and brake anti-dive control has been built into the new ball-joint front suspension of the Pontiac.

Other new chassis items include

suspended brake and clutch pedals, and throttle linkage.

Edsel's upper and lower suspension arms are mounted to the frame through rubber bushings. The lower arm has been swept back 20 deg, resulting in a trailing-arm-type suspension.

Upper ball joints are spring loaded to compensate automatically for wear. Helical coil springs are used. A torsional spring-steel link-type stabilizer is provided on 118- and 124-in. wheelbases. Direct-acting hydraulic shock absorbers work in conjunction with the front coil springs.

A new torsion sway-stabilizer bar is used on American Motors' 1958 Ambassador V-8 models. Linked between the lower control arms of the front suspension, body-roll is restricted. The bar is mounted in rubber to minimize road-noise transference. Ambassador also uses coil springs on all four wheels and "sea leg" shock absorbers.

Buick's 1957 ball-joint suspension has been redesigned. Retained are antidive geometry, a 7-deg directionally stable kingpin angle, improved steering ease, and durability of ball-joint pivots. The 1958 front suspension is lighter but stronger; the design accommodates either coil or air springs.

Solid metal bushings of the control arm shaft are retained. The front spring is located farther outboard, making it possible to use softer springs for the same wheel rate.

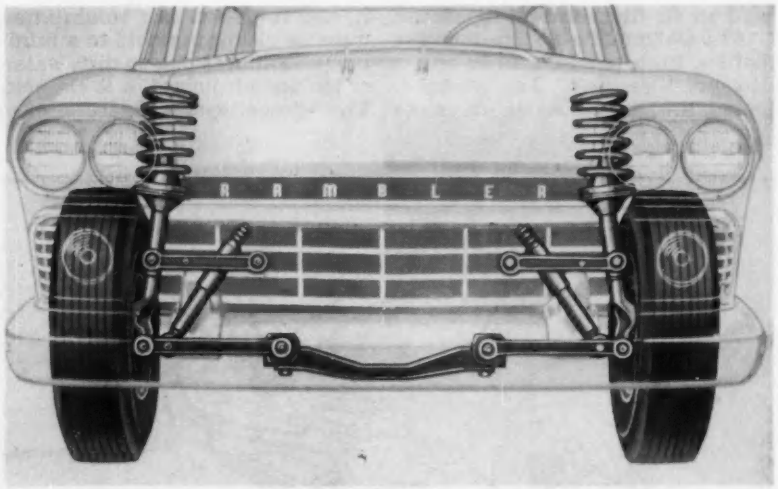
An important feature of the Ford line of cars is a new threaded bushing in the front-suspension upper arm, which is lubricated for life with a lithium-base lubricant. The new design has more effective dampening action.

Studebaker's new spring and shock rates, together with variable-rate coil springs, permit the car to adapt itself to road conditions irrespective of load. A link-type stabilizer has replaced the previous linkless bar.

The Torsion-Aire suspension system is standard on all Chrysler Corp. cars.

Chevrolet is also using coil springs, front and rear.

Studebaker is using a link-type stabilizer, replacing the previous linkless bar. This cuts roll and sway in cornering and offers stability in crosswinds.



LONG COIL SPRINGS are used on all four wheels of Rambler models. These springs, coupled with shock absorbers mounted in "sea leg" fashion, are said to give a smooth, stable ride. Front coil springs extend into special housings high in fenders.

Air Suspensions . . .

. . . are available on most 1958 cars. Advantages include level, constant height regardless of load, lower frequencies, improved handling, low center of gravity, better damping, and ability to "lift the body by its own bootstraps."

TECHNOLOGICAL progress seems to come by eras. The past 10 years have seen two outstanding engineering developments in passenger cars: (1) growth of larger, more efficient V-8 engines, (2) increased acceptance of automatic transmissions.

A new era—some call it the suspension era—started three years ago with the introduction by Packard of a torsion-bar suspension for passenger cars.[1] Last year Chrysler introduced its Torsion-Aire Suspension.[2] Cadillac also announced a new air suspension for its Eldorado Brougham.[3]

For 1958, all members of the Ford family of cars, other GM divisions, and American Motors Corp. have announced air suspension as optional equipment.

This fact needs emphasis: at present both conventional and air suspensions must be used in the same chassis. This may account, in part, for the fact that no two systems are alike. A difference in objectives, plus differences of opinion as to the best means of achieving these objectives, is an even more important factor in determining the 1958 air suspension designs.

Each of the new air suspension systems will be described in detail at the SAE Annual Meeting in January. Only highlights of several of the new systems can be given here.

Oldsmobile is using a "closed" system, only one of its kind in the industry. The system features automatic constant-height control, an extra-large high-pressure tank,

[1] SAE Transactions, Vol. 64, pp. 284–291: "New Packard Torsion Level Suspension," by F. R. McFarland.

[2] *SAE Journal*, Vol. 65, August, 1957, pp. 35–37: "New Chrysler Suspension System Features 9 Design Changes," by O. D. Dillman and R. R. Love.

[3] *SAE Journal*, Vol. 65, June, 1957, pp. 42–44: "3 Problems and How They Were Met in Developing an Air Spring for Passenger-Car Application," by V. D. Polhemus and L. J. Kehoe, Jr.

and an air filter and oil separator.

The Oldsmobile system includes both a high-pressure tank and a low-pressure tank. This makes it possible to take outside air, store it, and re-use it. Air volume that must be cleaned is held to a minimum. Failures due to dirt, water, or ice are minimized, it is claimed. The "closed" system operates even though the engine is not running.

An air filter and oil separator are used to purify outside air and separate oil vapor from it before it enters the system.

The Oldsmobile system uses a double-belt-driven compressor, copper tubing, and a unique sealed pipe joint.

Height control valves operate instantaneously to compensate for any change in either the load or the road. There are three height control valves.

A rubber-nylon diaphragm seals the bottom of the four air chambers. The high-pressure tank is held at 250–300 psi.

As more load is put on the chassis, the height control valves direct air from the high-pressure tank to one or several air chambers to compensate for added weight. As the load is diminished, air is exhausted from the chambers into the low-pressure tank near the left rear wheel.

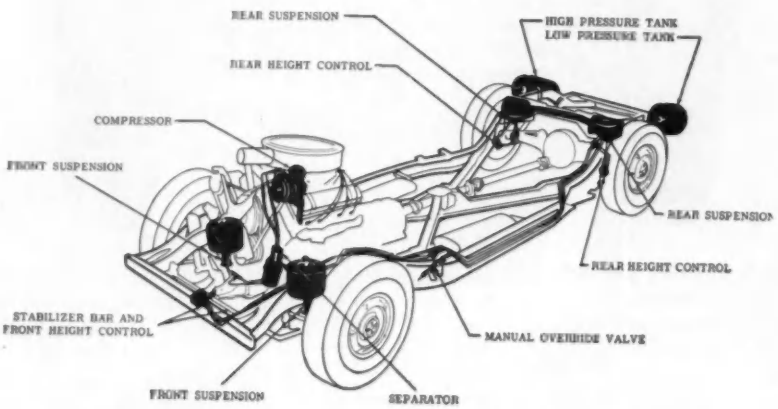
A manual override valve permits the driver to raise car height up to 4 in. if the front or rear bumper becomes lodged on an obstruction.

The air-suspension system used by the Ford line of cars is an example of the so-called "open" system. An air spring, consisting of a rubber bellows and piston, is located at each wheel. The effective supporting area of the air spring changes as the displacement changes, providing a variable-rate spring action that is soft in the mid-range and which stiffens considerably in both jounce and rebound when the piston is moved up and down.

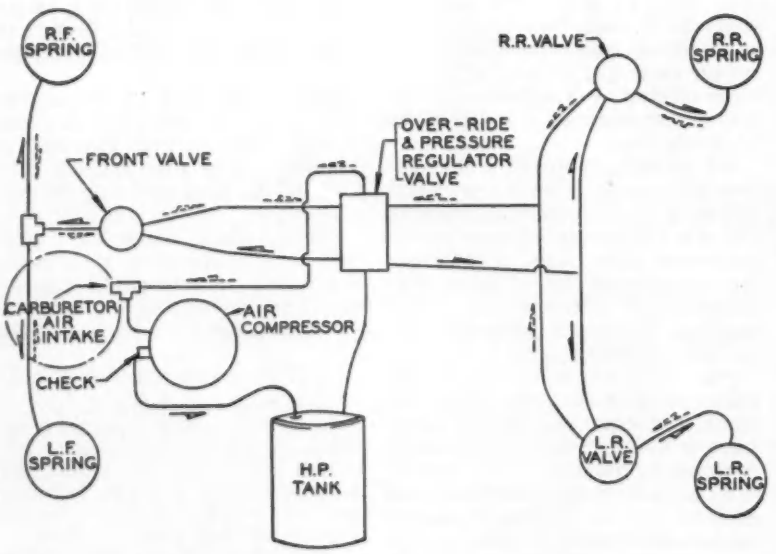
A network of valves permits either quick or slow leveling. Quick leveling compensates for major changes, such as occur when there is an increase or decrease in passenger load. Slow leveling compensates for temperature changes and small air losses. There is one valve for each of the front air springs and one valve for the pair of rear springs.

Front valves are mounted on the frame; the rear valve is mounted on the frame cross-member. Quick-leveling valves are triggered by a solenoid, which is actuated by the door courtesy light switch. The solenoid is energized when any door is opened to admit or discharge passengers. Leveling is accomplished normally in the time required for passengers to enter or leave the car.

Air pressure is supplied by a



OLDSMOBILE NEW-MATIC air-suspension system utilizes four compressed-air chambers, one at each wheel, to cushion ride. High-pressure air is supplied by twin-cylinder compressor that runs off engine. Air flows through oil separator and is pumped into high-pressure tank near right rear wheel. Three height-control valves, one behind front bumper that controls the two front springs and one at each rear spring, maintain car level at same height at all times. As more load is put on chassis, height control valves direct air from high-pressure tank to one or several air chambers to compensate for added weight. As load is diminished, air is exhausted from air chambers into low-pressure tank near left rear wheel.



PONTIAC AIR-SUSPENSION SYSTEM—air diagram.

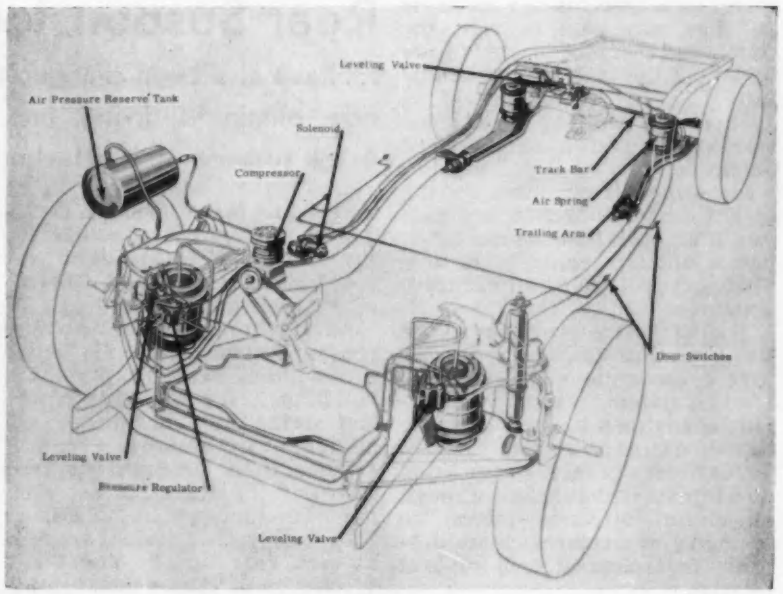
single reservoir tank. The compressor is mounted on the engine. Maximum output pressure is 325 psi. Air pressure for the front air springs is 115 psi; rear air spring pressure is 95 psi.

Buick's Air-Poise system provides (1) variable-rate suspension, (2) automatic leveling, (3) automatic trim control, and (4) manual lift.

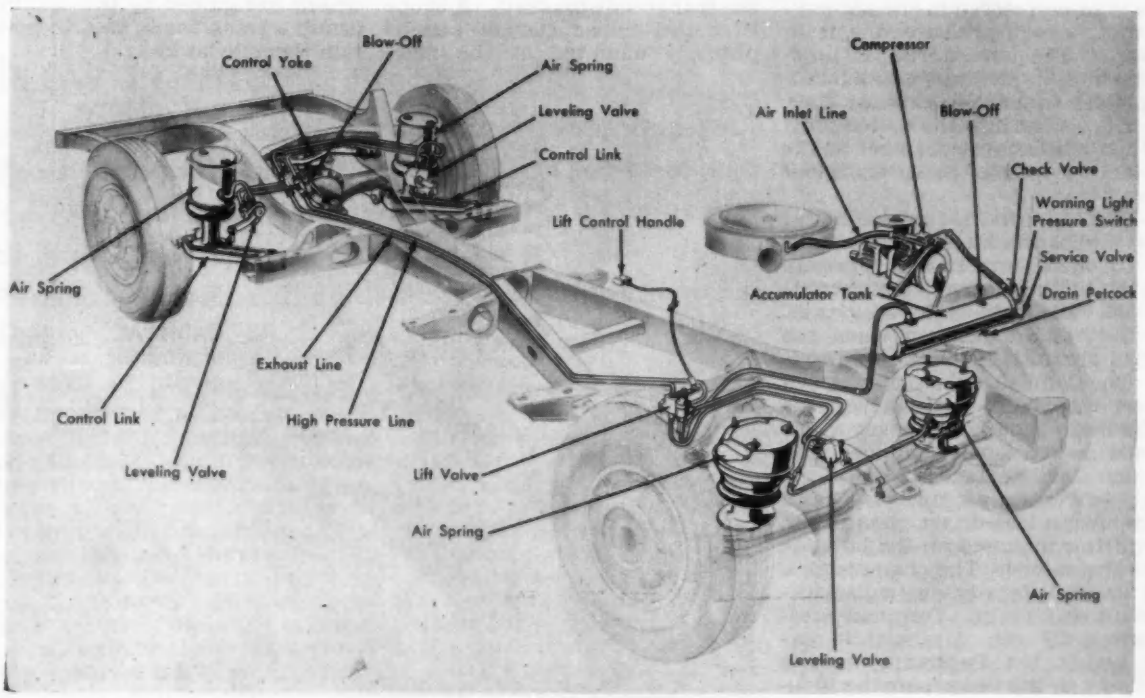
Normal designed pressure of the Buick air springs is 100 psi. Effective area of the rear springs is 10 sq in.; area of the front springs is 20 sq in. Designed spring rates at design height are 60% of the present coil springs. Rear spring volume is 235 cu in. These rates start to increase when the car is a certain distance above or below design height.

Buick uses what is described as a "modified closed" system. In this setup, air discharged from the springs is returned to the compressor by return tubes. Air is lost from the system only when the springs discharge while the engine is not running. This reduces the problem of air makeup.

The high-pressure tank varies from 125 to 290 psi. The tank is mounted between the frame side rails and directly behind the front cross-member. The tank also



FORD AIR-SUSPENSION SYSTEM. Leveling control system consists of two front and one rear leveling valves, a solenoid, and the door courtesy light switches, to allow quick leveling when load changes occur and slow corrective leveling otherwise. Leveling valves maintain constant car height by admitting air to, or exhausting air from, air springs as load in car changes. Quick leveling system operates through door courtesy light switches. When any door is opened to admit or discharge passengers, solenoid is energized and rapid leveling takes place. With doors closed, filling or exhausting of air springs will take place slowly to compensate for disturbance in load, such as person shifting his position inside car or incorrect trim obtained when trunk is loaded.



CADILLAC AIR-SUSPENSION SYSTEM.

serves as a trap for any water or oil that may pass through the compressor. A plug located in the bottom of the tank permits draining.

There are two rear height control valves and a single front height valve.

An orifice is provided in the height control valves to minimize loss of air each time the car hits a bump and to control hunting. This prevents use of an excessive amount of air.

The lift valve provided in the Buick system can raise the car over 4 in. while sealing off the leveling system. This device permits changing a tire and may also be used during assembly.

Chevrolet's Level Air suspension also adjusts vehicle height through air-spring leveling valves so springing characteristics are uniform, regardless of load or load location.

The Chevrolet system includes an air cleaner with an alcohol receptacle to prevent icing in cold weather. Other components are a compressor, a high-pressure accumulator, air line junction block, a bellows and reservoir at each wheel, leveling valves, and air lines.

A metered amount of air is taken from the atmosphere through the alcohol to the compressor and stored in the accumulator. A high-pressure line leads from the accumulator to the junction block, which serves as a manifold for feeder and exhaust lines. Air is forced into the system only when the exhaust chamber of the junction block lacks sufficient pressure.

When a passenger enters the car or the load is increased, air flows into the reservoir and pressure rises in the system. This maintains adequate ride clearance. Pressures are reduced when the load diminishes.

The Cadillac air-suspension system introduced last year on the Eldorado Brougham is now available as optional equipment on other Cadillac models.

The Pontiac air ride suspension includes a belt-driven compressor, which is mounted on the left side of the engine. The compressor is a 90-deg V-type having a displacement of 5 cu in. Terminal pressure is 250 psi. A schematic diagram of the Pontiac system is shown in the accompanying illustration.

Rear Suspensions . . .

. . . have also been changed to provide a better, smoother ride, eliminate diving, and to increase stability. New 4-link suspension is attached to the frame at four points.

THE 4-link rear suspension developed originally by Cadillac for the Brougham is standard this year for all Cadillac cars. Chevrolet is also using a 4-link type.

Advantages of the 4-link suspension system include (1) better ride without sway, (2) improved handling, (3) elimination of the leaf spring friction variable, (4) all forces are absorbed ahead of (rather than behind) the rear axle, and (5) the roll center is almost 6 in. higher than in 1957.

In Cadillac, coil springs are used at each rear wheel. The 4-link suspension permitted modification of the tubular center X-frame introduced last year by Cadillac. This change also makes it possible to increase trunk space.

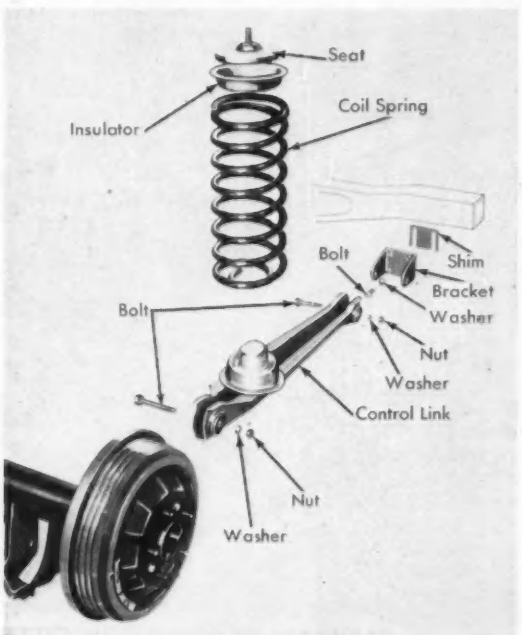
The Chevrolet 4-link rear suspension features control arms extending from the frame to the axle in a geometric pattern that maintains consistent alignment. Lower control arms at each wheel are pivotally anchored at their forward end to frame brackets and at the rear to axle brackets. A single U-shaped upper control arm is pivotally mounted at the rear-axle housing and curves upward to frame side member brackets. Shock absorbers are located between the rear section of the lower control arms and the frame. According to Chevrolet engineering tests, this arrangement virtually eliminates squat and lift during acceleration and stopping.

Lincoln has a new trailing-arm rear suspension with coil springs that is said to provide better handling, better ride, and to eliminate dip and rise on acceleration and braking.

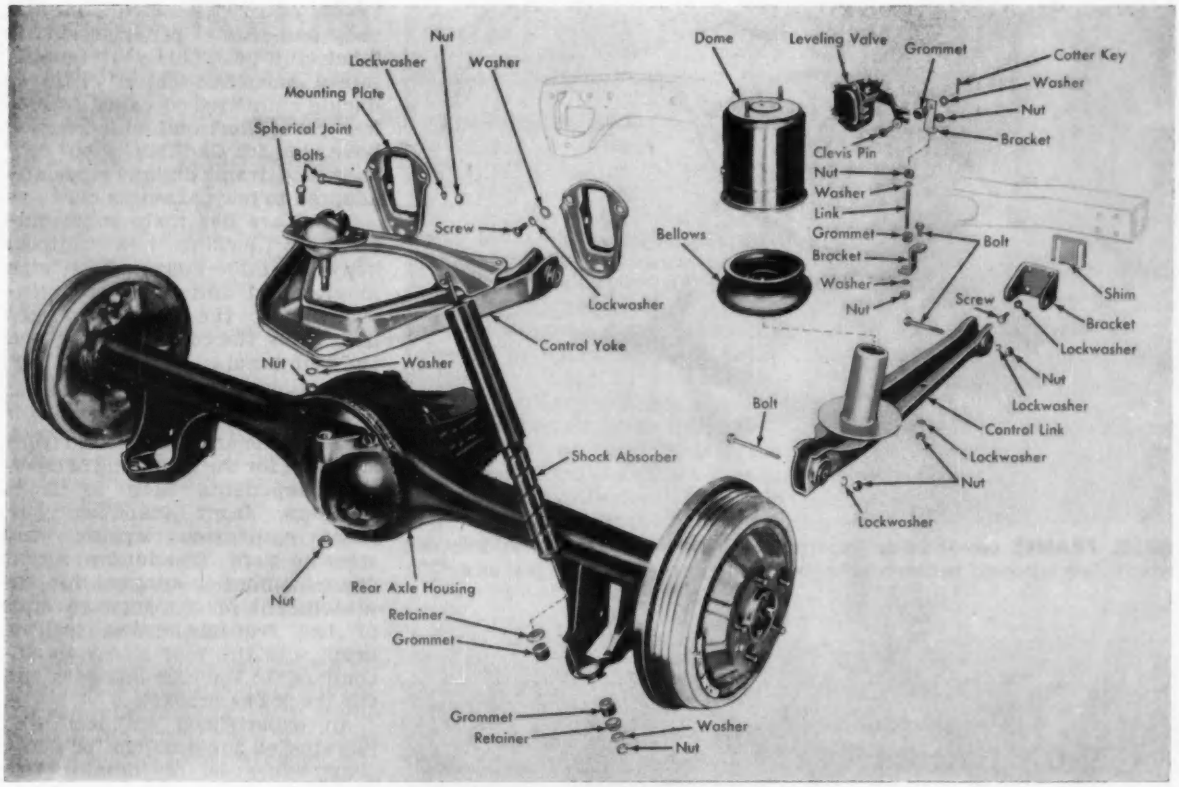
Studebaker-Packard has longer rear leaf springs, set back slightly from center over the rear axle to prevent dipping during sudden starts and stops.

On all Dodge, DeSoto, Chrysler, and Imperial models and on Plymouth station wagons, rear springs have been lengthened by 2 in. An extra leaf has been added to the rear springs on other Plymouths.

The Ford rear suspension is completely new to provide for installing air springs. Rear axle and wheels are guided by two trailing arms; a track bar is used to position the axle laterally.



CADILLAC method of attaching rear suspension to frame—exploded view.



CADILLAC REAR SUSPENSION—exploded view.

New Frames . . .

. . . are designed to permit lower cars with step-down floors while providing added stiffness and torsional rigidity. Pontiac and Chevrolet have adopted a modification of the X-type tubular frame introduced last year by Cadillac. Edsel and Buick also have interesting new frames.

NEW frames with a tubular center X have made possible much lower bodies for Cadillac, Pontiac, and Chevrolet and a new concept in styling. The change has been made with very little change in weight or cost, it is indicated.

The Eldorado Brougham had 15% greater torsional rigidity than the frame for a 1956 Cadillac 4-door hardtop. Beaming stiffness is reported up 100%. Chevrolet has indicated a 30% improvement in rigidity. Pontiac claims greater torsional stiffness and less vertical deflection for maximum stability and strength.

Chevrolet engineers point out that, with the new Chevrolet frame, when a wheel passes over a bump, the result is bending rather than a twist. The reaction at the tubular center section is torsional and is readily absorbed, it is reported.

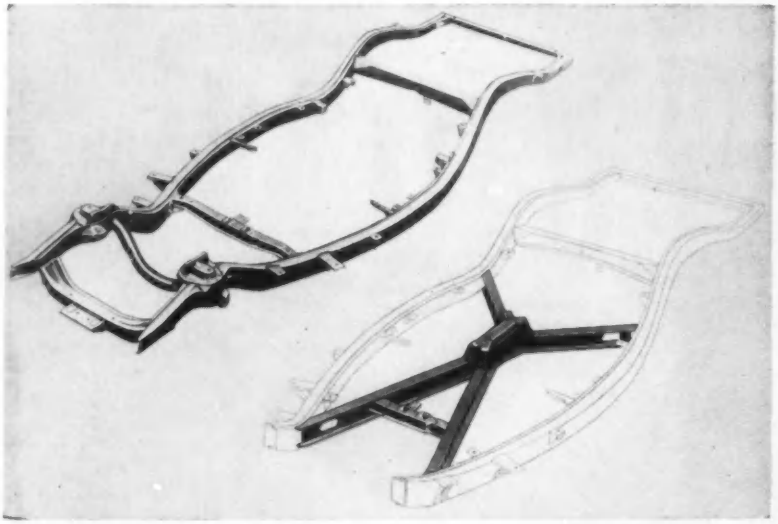
There is also maximum integration between body and frame in the 1958 Chevrolet and Pontiac. Several underbody cross-members are increased in section and rigidity. In Chevrolet, body rocker panels have been extended to the dash panel, stiffening the body forward area.

Buick is using two frames; one is for air suspension, the other is for conventional suspension. On Air-Poise cars, the rear-spring cross-member is open above the spring seats. In other respects the frames are similar. The 1958 frames have wider side rails at the rear. Front spring cross-members are larger and are made of heavier material.

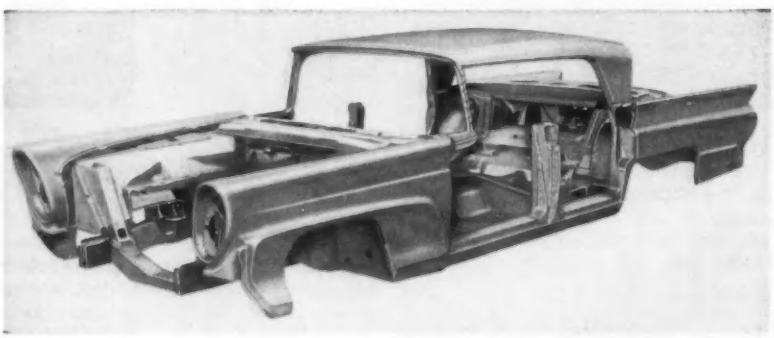
In Cadillac the beams which Y-out rearward from the tubular center have been widened, moving them outside the body.

The new Edsel frame is of the ladder type, with box section side rails, which flare outboard between the axles, permitting a depressed floor pan area. This provides adequate foot room and a lower silhouette. The convertible frame has four cross-members plus an X member.

The competitive situation be-



EDSEL FRAMES are of ladder-type construction, with box section side rails, which flare outboard between axles, permitting depressed floor pan area.



LINCOLN'S UNITIZED BODY has greatly increased torsional rigidity. Basic strength is in center portion of underbody, which extends from front torque box at front end of side sills to rear torque box at rear end of side sills.

tween unitized construction and body-and-frame construction is touch-and-go. This year Lincoln joined American Motors in introducing a unitized so-called frameless car. Chevrolet and Pontiac have joined Cadillac with new body-and-frame designs especially adapted to low passenger cars.

There are five main subassemblies to Lincoln's new unitized body: the underbody or floor, with longitudinal and tranverse reinforcements, the left and right body sides, the cowl assembly, and the roof panel.

Mounting Components

Provisions are made in the front side rails for the mounting of chassis components such as front bumpers, front stabilizer bar, front suspension, engine, and steering gear. In addition, a rear cross-member is adapted for the attachment of the forward ends of the rear-suspension trailing arms, and the rear side rails accommodate the axle bumpers and the track bar brackets.

An experienced engineer who has studied the problem for many years expressed his opinion this way: "If you're willing to trade $100 for 100 lb of steel you can go along with the unitized body."

Higher labor costs and the longer assembly lines needed for unitized bodies are apparently two of the major obstacles ahead of unitized bodies. The fact that both basic types of construction co-exist tends to indicate, however, that there are very good reasons for both the body-and-frame and unitized construction.

Tires, Rims and Wheels . . .

. . . are changing to meet new requirements. Chrysler offers 14-17-psi low-pressure tires; more producers adopt safety rims.

NEW 11.00 × 14 low-pressure, Custom Super Soft Cushion Tires will be available on Chrysler Imperial as an optional item. These are reported to be the largest and softest riding tires ever offered for U. S. cars.

Recommended pressure for normal use is 17 psi in front and 14 psi in the rear. The new tires are expected to be available in limited quantities during 1958.

Double-walled "captive air" tires will be standard on DeSoto and Chrysler 9-passenger station wagons in 1958 and on Studebaker-Packard Hideaway Seat station wagons. This is the first time, in recent years at least, where the manufacturer has been bold enough to eliminate the spare tire.

Safety rim wheels are standard on all Edsels.

Cars now using 14-in. wheels include Chevrolet, DeSoto, Dodge, Edsel, Ford, Lincoln, Imperial, Oldsmobile, Studebaker-Packard, Plymouth, and Pontiac. All 14-in. tires have larger cross-sections than the 15-in. tires they replaced.

Brakes Feature . . .

. . . better cooling and improved performance. Edsel and Lincoln-Mercury have new self-adjusting brakes. Chrysler has new Hi-Temp brake fluid.

BUICK is offering aluminum front brake drums on its series 50, 60, 70, and 700, increased total brake lining area, and an improvement in brake operation and heat dissipation.

The backing plate is piloted directly on the wheel spindle. A minor change has been made in brake attachment. A grease- and water-proof seal is used around the spindle.

Brakes are 12 in. in diameter; all front brakes are 2½ in. wide. Brake lining area on all models is 218.0 sq in. (gross), an increase of 9.0% on most models.

Aluminum, aircooled drums are standard on Century, Super, Roadmaster, and Limited. The aluminum brake drums are a bimetallic design. The liner is rough-machined on the inside diameter. After preheating, it is placed in a permanent mold and aluminum is poured into the mold cavity to form the body of the drum.

Advantages claimed for the new design include better thermal conductivity, heat storage, and heat removal.

With the Edsel automatic brake adjuster, periodic adjustments are eliminated. The automatic brake adjusting screw is rotated by a stamped lever, which is actuated by a cable and coil spring. The adjusting action takes place on reverse braking.

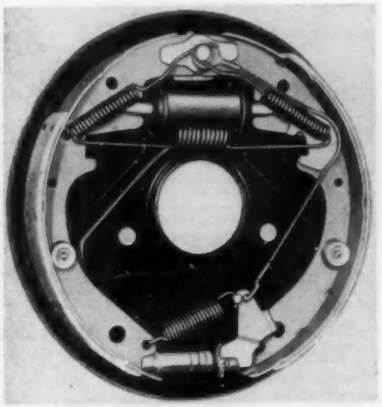
Lincoln and Mercury have lowered the brake pedal ¾ in., bringing it close to the level of the accelerator. Front brakes have been increased in width ½ in., to 3 in.; rear brakes are 2.5 in. wide.

Cadillac has introduced new brake linings and a new brake booster.

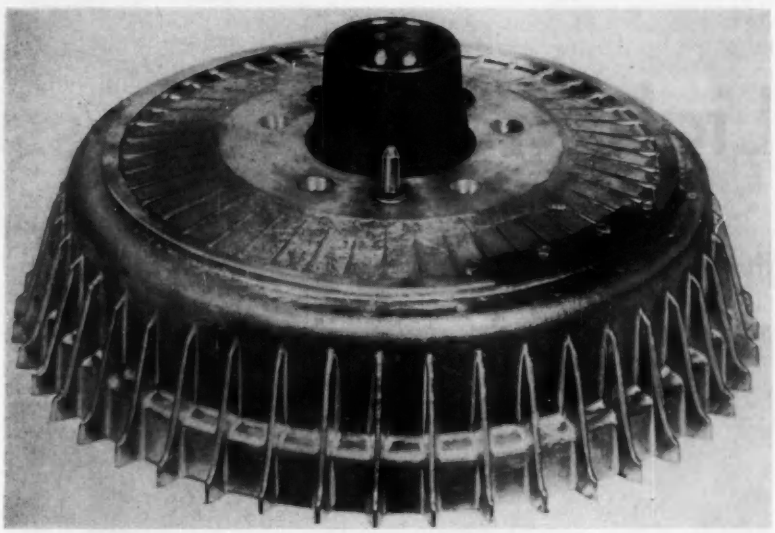
American Motors has a new step-on parking brake with a convenient T-handle release.

Safety-Fin Studebaker-Packard brakes are said to double the surface of the drums. The brakes are self-energizing and self-centering. Proving ground tests show these brakes were more effective after six full stops than on the first stop, according to S-P engineers.

Another important development in brakes is the introduction by Chrysler of a new Hi-Temp brake fluid to be used in conjunction with Chrysler's Total Contact brakes. The new brake fluid has a boiling point of 390 F, almost 100 deg higher than called for in the SAE heavy-duty brake fluid standard. Hi-Temp brake fluid is standard on all 1958 Chrysler Corp. cars.



EDSEL AUTOMATIC BRAKE adjuster eliminates periodic brake adjustments. Automatic brake adjusting screw is rotated by stamped lever, which is actuated by cable and coil spring. Adjusting action takes place on reverse braking.



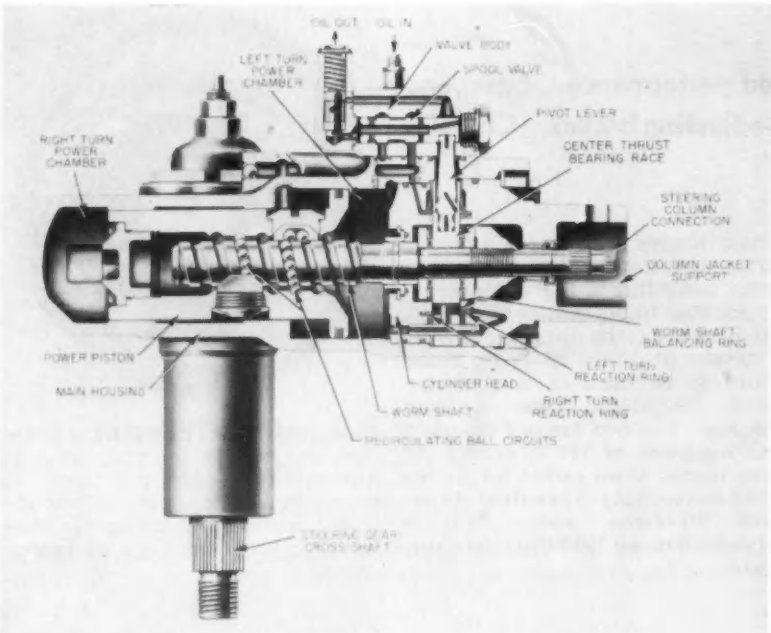
BUICK CAST-ALUMINUM BRAKE DRUM is of bimetallic design.

Steering in 1958 . . .

. . . has been made easier. Chrysler has a new constant-control power-steering unit. Refinements have been made in a number of steering arrangements.

SIMPLER and more compact than the earlier Chrysler power-steering unit, the new mechanism retains the company's full-time assist feature. Only 3½ turns of the wheel are required to turn the wheels from full right to full left. Available on all Chrysler Corp. cars, the new unit is standard on Chrysler Saratoga, New Yorker, and Imperial models.

In conjunction with its recircu-



lating ball and nut steering gear, Edsel will offer a linkage-type power-steering assist. The unit includes a power cylinder, control valve, pump, and reservoir, which are added to the original steering installation.

Chevrolet has a forward-mounted steering linkage that is said to provide more responsive action and to reduce road vibration to the steering wheel.

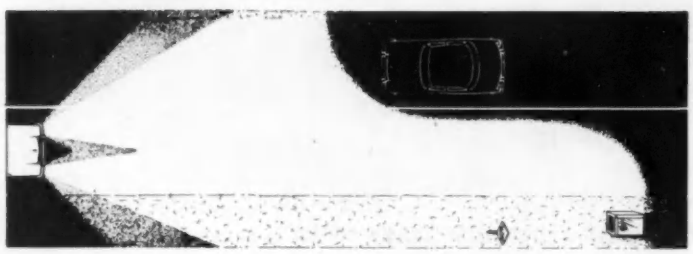
Buick has lowered the tie-rod pivot ball at the steering arm. A new steering knuckle and arm unit is specified.

Oldsmobile has a new safety-vee steering wheel recessed to the steering column. Rectangular horn buttons, located in the spokes, replace the horn ring.

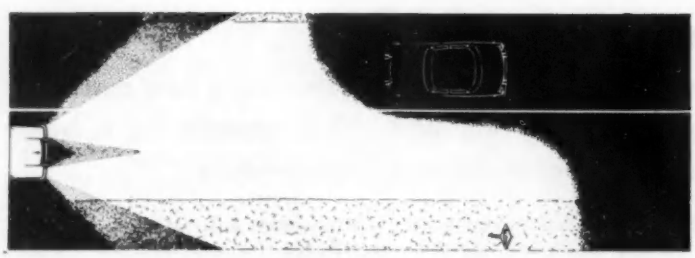
CHRYSLER CONSTANT-CONTROL power steering is shown on this cut-away drawing.

Lights and Accessories . . .

. . . are being improved to emphasize safety. Four-lamp lighting, now standard throughout the industry, improves the lower beam.



1958 low beam



1957 low beam

FORD DUAL HEADLIGHTING SYSTEM. Low beam of new system is compared with low beam of 1957 headlighting system.

THE 4-lamp dual sealed-beam lighting system developed cooperatively by engineers of the automotive industry and the American Association of Motor Vehicle Administrators has been accepted by the entire industry. SAE committees have developed standards for such lighting.

The new lighting system was described in detail in the *SAE Journal*, December 1956, p. 36.

Outer lamps, with both high and low beams, are for city driving. On low beam, greater wattage is available than on the conventional 2-lamp system, providing greater illumination where it is needed most. The high beam of the outer lamps provides soft, general lighting for open highway driving. It is used in conjunction with the single high beam of the inner lamps. The new system casts low-beam light 75–100 ft farther than the single-light system.

Dual headlamps are standard on

Studebaker Commander and President series and optional on the Champion series. They are also standard on 1958 Ramblers except the deluxe series.

Car manufacturers have provided greater generator output to meet the requirements of the new dual headlamps.

Dual tail lamps are also increasingly popular. The tail light and turning signal of the new Edsel is extended into the deck lid, producing a striking effect.

Instrument Panels . . .

. . . have been redesigned for better vision and speed-warning devices are catching on with the public. Other accessories for easier operation include 4-stream washers, electrical controls for ventipanes, and rear-window defroster.

MOST car producers have redesigned their instruments and instrument panels to provide improved visibility. Public acceptance of speed warning devices is reflected by the fact that 80% of 1957 Buick buyers ordered Speed Minders. A modification of the Buick buzzer-type device will be available on Oldsmobile and Pontiac in 1958.

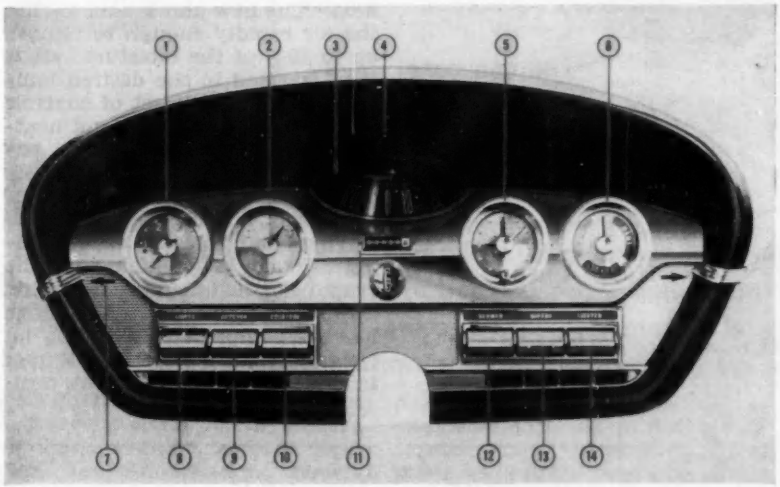
Edsel has introduced a speedometer, which glows red when a given speed is reached. Mercury has a warning bell. Chrysler's Auto-Pilot speed warning device has already been described under "Transmissions and Drive Controls."

For the first time, Chrysler is introducing 4-stream electrically driven windshield washers that double the cleaning power of previous washers. Chrysler is also offering a rear windshield defroster as an accessory.

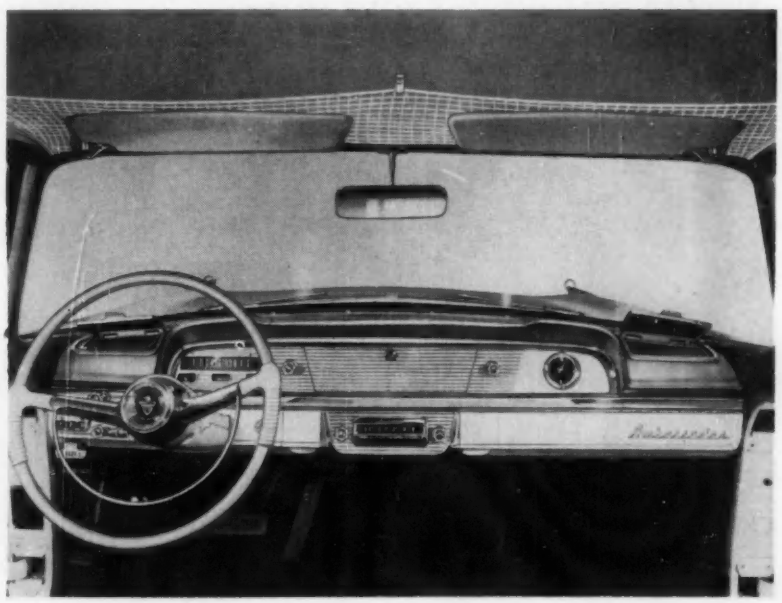
New transistor-equipped radios promise to be more trouble-free than existing radios. The new radios are portable. Advantages include reduced power consumption and instant reception.

Ventipanes on several of the luxury cars can now be opened and closed electrically by pushing a button.

Power seats and power lubrication are increasingly popular.



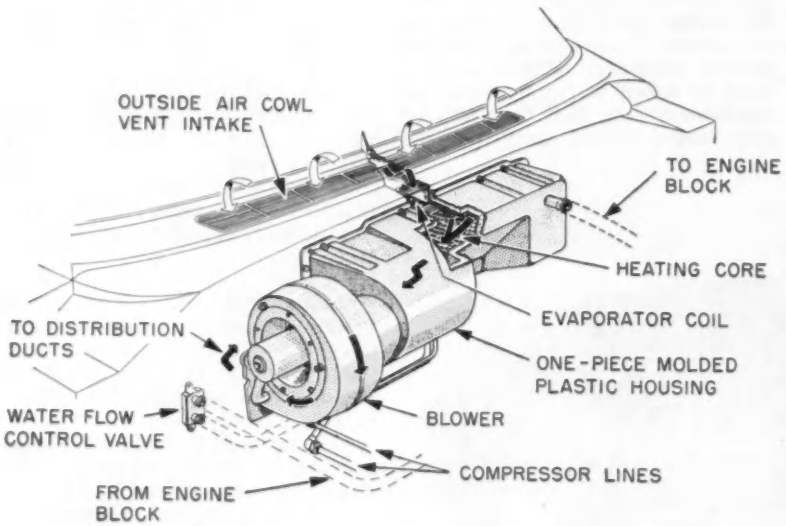
INSTRUMENT PANEL of Edsel showing (1) tachometer, (2) fuel gage, (3) speedometer, (4) high-beam indicator, (5) clock, (6) heater control and/or air conditioning, (7) turn signal indicator lights, (8) headlight switch, (9) antenna control switch, (10) courtesy light switch, (11) odometer, (12) heater blower control, (13) windshield wiper control, and (14) cigarette lighter.



INSTRUMENT PANEL of American Motors Ambassador. Pushbutton controls for automatic transmission, and controls for air conditioner and heater are located in cluster to left of steering wheel.

Heating and Ventilating . . .

. . . controls have been simplified. Considerable attention has been given to air distribution.

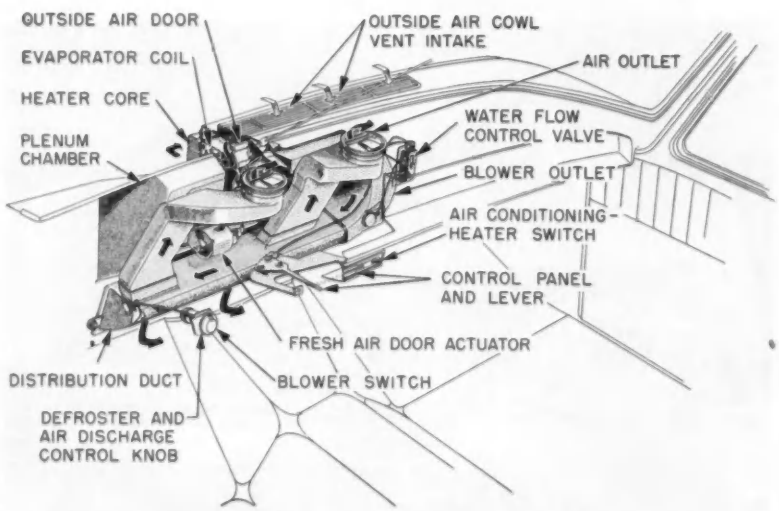


CHRYSLER HEATER-AIR CONDITIONER from engine compartment side.

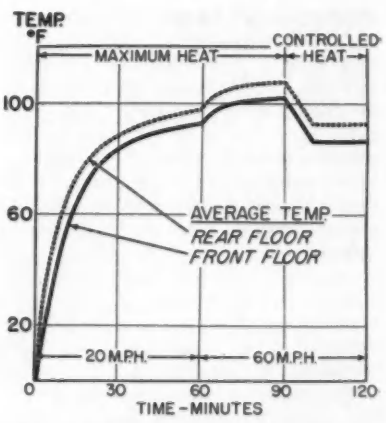
A VACUUM - operated, fingertip control is used for all heating, defrosting, ventilating, and air conditioning requirements in the Ford family of cars. A single dial is mounted on the instrument panel. The 3-stage engine cooling arrangement to insure fast warmup has already been described.

The Chrysler Airtemp air conditioning unit uses a novel method to take care of humidity as well as heat. The new unit is said to chill the air rapidly enough to remove up to 70% of the moisture; air is then warmed to the desired temperature. A single set of controls is used for both cooling and heating. Additional insulation has been added and there is more blower capacity. Windows can be kept clear, it is claimed, under all driving conditions. A super cooling package is available with the evaporator installed in the trunk.

Rear seat heating in the Buick has been improved by adding an element to the perimeter unit used in 1957. The new underseat, radi-



CHRYSLER HEATER-AIR CONDITIONER from front compartment side.

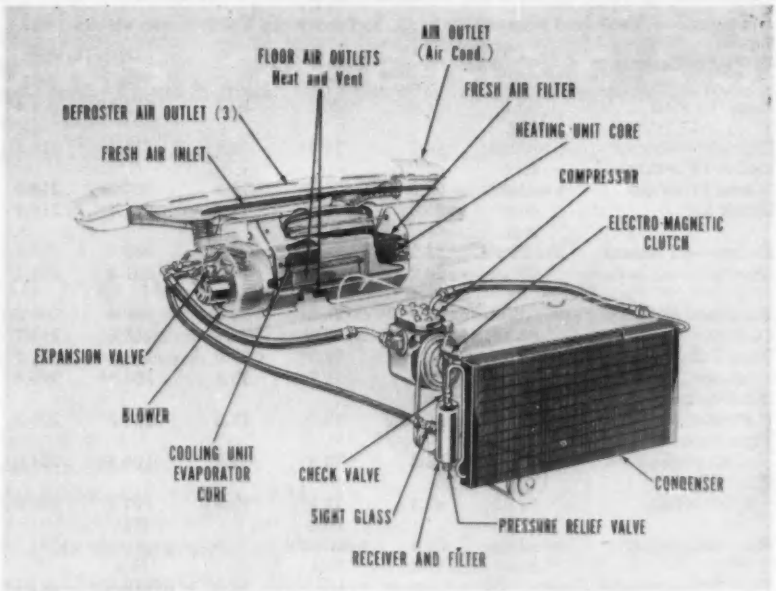


BUICK CAR HEATER performance graph shows improved heating on rear floor.

ant heater is installed under the front seat for 1958.

Changes in Buick air conditioning include (1) greater condensing capacity, (2) increased compressor displacement, (3) restyled outboard outlet grille, (4) redesigned instrument panel outlet, (5) new, larger evaporator, (6) increased insulation.

Cadillac also has single knob control. Underseat heaters are available.



ALL-SEASON air conditioner for Ambassador and Rambler models combines cooling, heating, ventilating, and defrosting in one unit.

Bodies . . .

. . . are again longer, lower, and wider; bigger windshields and backlights are favored; both 14-in. and 15-in. wheels are being used; low, horizontal grilles are favored, but one maker emphasizes vertical lines; "sculptured metal" is widely employed; twin headlamps sweep the field; station wagons are moving up fast.

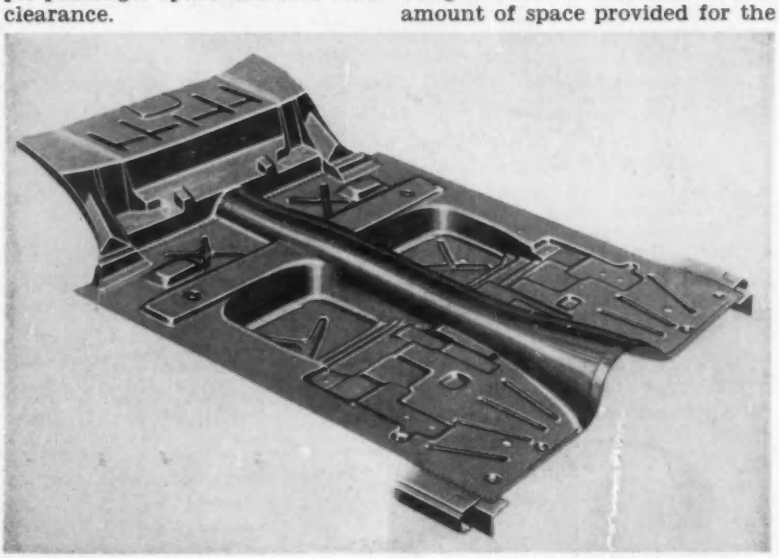
ENTIRELY new bodies have been introduced this year by Chevrolet, Edsel, Pontiac, Lincoln, Rambler, and Ambassador. Several producers, including Studebaker-Packard, introduced new lines of cars. A number of manufacturers ordered "major face-lifts," sometimes almost as expensive as a new body.

Overall height of passenger cars has been greatly reduced during the postwar period and particularly during the past few years. Again this year the reduction in car height has been substantial on some models. Pontiac, for example, lowered the ground-to-roof height of one of its models 4.5 in. this year. As it changed over from body-and-frame construction to integrated body and frame, Lincoln lowered the body height by 3.8 in.

A study of Table 2 indicates, on an average, American passenger car bodies were lowered 2.9 in. in 1957. This trend, which continues in 1958, started nearly 20 years ago. The big question seems to be: Is this the end? The engineers' answer seems to be: the end has not been reached as long as engineers continue to devise new frames, new suspensions, and other ways of keeping overall car height down while providing ample passenger space and safe road clearance.

Most cars are longer this year. As shown, some Chevrolet and Lincoln models are 9 in. longer than the 1957 models.

While reducing overall height, designers have maintained the amount of space provided for the



FLOOR PAN of Edsel utilizes spot-welded reinforcements in critical sections to increase strength.

Table 2—What Has Happened to U. S. Passenger Cars—1946 versus 1957

1957 Model Designation	Height (Unloaded) 1946	Height (Unloaded) 1957	Width 1946	Width 1957	Overall Length 1946	Overall Length 1957
Cadillac 60 S	63.1	61.0	80.8*	80.0	224.75*	224.4*
Chrysler Windsor	Not available	58.6	77.8[g]	78.8	214.2[g]	219.2
DeSoto Firedome and FireFlite	Not available	58.6	75.6[h]	78.2	207.2[h]	218.0
Buick 50	65.0[a]	61.0	78.6[a]	77.6	212.4[a]	215.3
Dodge—all sedans	Not available	58.2	74.9[i]	77.9	205.6[i]	212.2
Mercury—all sedans	69.1	58.2	73.5	79.1	201.8	211.1
Nash and Hudson	Not available	Not available	75.4[j]	78.0	199.6[j]	209.2
Olds 98	65.1[b]	59.8	76.0[b]	76.4	213.0[b]	216.7
Ford Custom and 300	69.5[c]	58.9	73.5[c]	77.0	196.0[c]	201.7
Pontiac Chieftain	66.0[d]	62.0	75.7[d]	75.2	204.5[d]	206.8
Studebaker President	67.0[e]	Not available	72.7[e]	75.8	197.8[e]	206.5
Plymouth —all sedans	Not available	58.2	73.6[k]	78.2	196.7[k]	204.6
Chevrolet —all sedans	69.4[f]	61.5	72.6[f]	73.9	197.7[f]	200.0
Rambler Sedan	Not available	59.4	Not available	71.3	Not available	191.1
Ford Thunderbird	Not available	Not available	Not available	72.8*	Not available	181.4*
Nash Metropolitan	Not available	54.5*	Not available	61.5*	Not available	149.5*
Industry Average for 1952-1957 (Based on AMA figures)						
1957		59.6		77.4		210.6
1956		62.5		76.5		210.0
1955		62.8		76.2		209.0
1954		63.5		75.2		209.5
1953		63.9		75.7		206.2
1952		64.0		75.8		204.8

Averages are based on a larger number of cars than those shown here. Models compared are not always strictly comparable, but the 1957 model may be thought of as having evolved from the earlier model.

* Indicates that this car was not used in computing averages.

[a] Buick 50. [b] Olds 6 and 8. [c] Ford V-8. [d] Pontiac 6. [e] Studebaker 6. [f] Chevrolet 6. [g] Chrysler C 39. [h] DeSoto 6. [i] Dodge 6. [j] Nash 600. [k] Plymouth 6.

Courtesy, American Motors Corp.

car occupants. The recent 3–4-in. reduction in roof height has been maintained by a combination of design changes:

1. A slight reduction in ground clearance.
2. Modification of frame and body sill structure.
3. Lowering the passengers within the body structure.
4. Using a step-down floor pan.

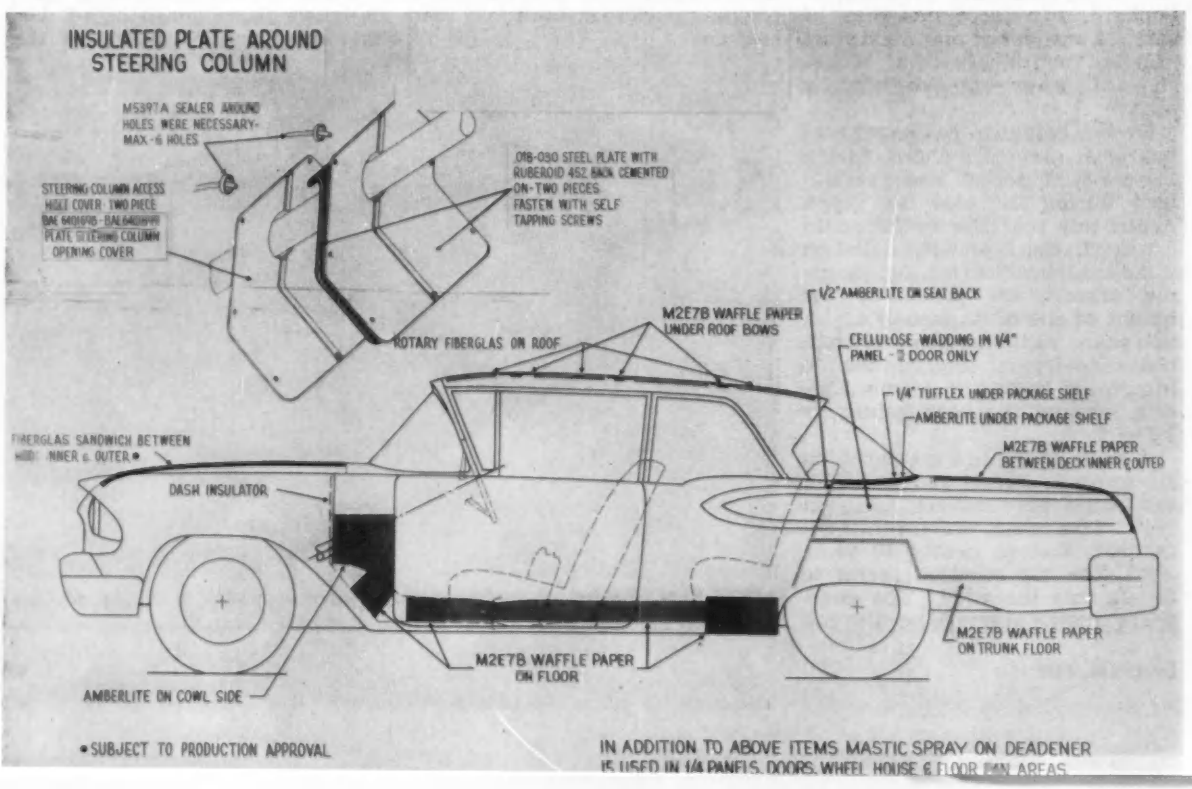
The trend toward regrouping to provide better visibility of instruments continues. Simplification of controls has also been achieved in a number of new models. A few models will provide tachometers.

Evidencing the growing popularity of aluminum grilles is the fact that 13 of the 1958 models have aluminum grilles. Some grilles are die cast; others are assemblies of extruded shapes. The ability of design engineers to obtain interesting new effects with aluminum grilles is an outstanding achievement.

New production methods may help prolong the life of automobile bodies. Both American Motors and Lincoln have announced that they are dipping the body either wholly or partially in a rust-resisting primer to prevent premature rusting.

The choice of colors offered to car buyers is expanding. Chrysler, for example, is offering 86 solid hues and 371 2-tone combinations of Follow-the-Sun colors

MERCURY noise sound-proofing diagram.

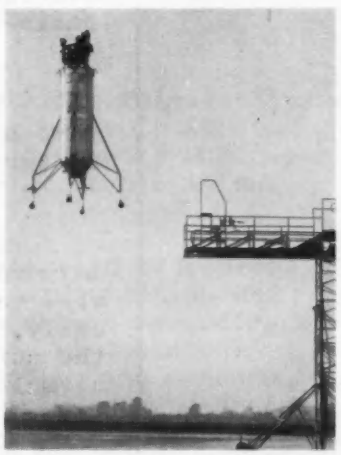


SAE LOOKS OVERSEAS

by **JOHN JAY IDE,** *who last Spring revisited places and friends in Europe where, for many years, he represented the National Advisory Committee for Aeronautics. He is now consultant to the chairman of NACA, and member of the SAE Aircraft Activity Committee.*

THE FLYING ATAR

While in Europe last Spring, I witnessed the first public demonstration of the Flying Atar, development of which Société Nationale d'Étude et de Construction de Moteurs d'Aviation (SNECMA) started about five years ago. The first free flight of the Flying Atar in May, 1957 lasted 4 min 15 sec, and Auguste Morel was at the controls. All previous flights had been made under tethered conditions in a gantry by a radio-controlled first version of the machine.



SNECMA "Flying Atar" C-400 P.2 piloted by Auguste Morel. Pilot reaches his seat by gantry shown at right.

The first public demonstration (in June) was easily the most impressive exhibit of the opening day of the "Fete Aerienne" at Le Bourget airfield near Paris. . . . The machine rose in a cloud of dust and moved across the field to a position in front of the official tribune. Then it suddenly rose to about 600 ft, descended to 100 ft above the ground, swung gently back and forth, spun around on its axis to show its controllability and then flew back to its take-off area.

The spectators seemed awed by its possibilities.

SECOND VERSION

This machine was the second version of the Flying Atar design. Designated the P.2, its engine is an Atar DV having a maximum thrust of 6390 lb. The total take-off weight is 5730 lb, composed of:

4410 lb—aircraft weight
1100 lb—fuel "
220 lb—pilot "

(Continued on next page)

This feature is an activity of the SAE OVERSEAS INFORMATION COMMITTEE, C. G. A. Rosen, chairman

• SUBJECT TO PRODUCTION APPROVAL
IN ADDITION TO ABOVE ITEMS MASTIC SPRAY ON DEADENER
IS USED IN 1/4 PANELS, DOORS, WHEEL HOUSE & FLOOR PAN AREAS

SAE LOOKS OVERSEAS

(Continued from preceding page)

Thus the total thrust is 12% greater than the weight at take-off.

The cylinder housing of the engine is 19.7 ft high and 4.9 ft in diameter and is supported by a landing gear with four caster wheels. The pilot sits on an ejection seat mounted above the air intake.

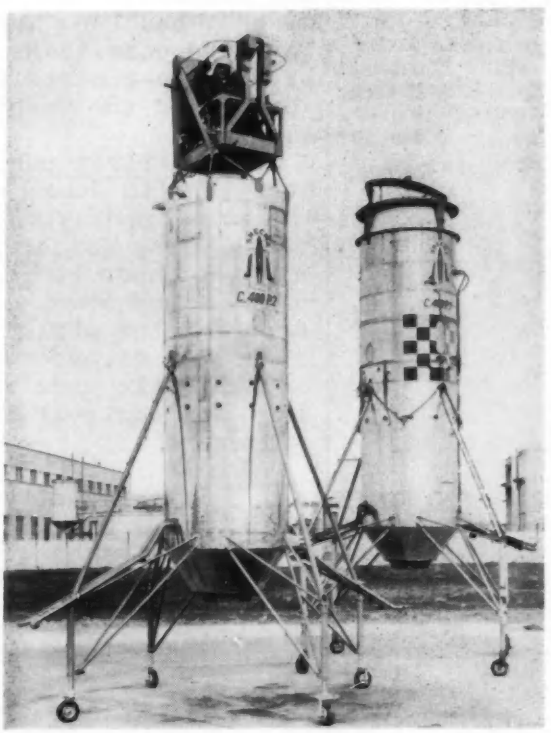
The first version of the Flying Atar (the P.1), started five years ago, had been tested in more than 250 radio-controlled flights at Melun-Villaroche.

The P.2 will be followed by the P.3, which will have a cabin and swinging ejection seat to train pilots in vertical take-off.

SNECMA is now building an annular-wing "coleopter" aircraft to the design of Von Zborowski. This aircraft will take off vertically, then swing to the horizontal for normal flying.

A NEW "COLEOPTER"

The stability control of this "coleopter" is obtained by air bled from the compressor and emitted through outlets in the casing walls. The development time for this was shortened by the work already done in designing the SNECMA thrust-reverser. (Details are disclosed in a paper by G. Ernst of SNECMA read before the Association Technique Maritime et Aéronautique in Paris last June.



SNECMA "Flying Atars": Left: The C-400 P.2 carrying pilot in ejection seat. Right: The C-400 P.1 radio-controlled apparatus.

SAE LOOKS OVERSEAS

by G. KONINCKX, *Sabena, Belgian World Airlines*

AIRLINES POOL INFORMATION AND PARTS FOR MUTUAL BENEFIT

In 1949, a group of European operators got together to form a pooling operation known as the Beneswiss Agreement. This Agreement would provide for the pooling of technical know-how. In addition, out of the Beneswiss Agreement came the pooling of spare parts, tools, equipment, manpower, and costs. Interchangeability problems with the then new Convair 240 revealed mutual benefits to be gained from such a pool.

DUPLICATION OF INVENTORIES AND MANPOWER IS ELIMINATED

Beneswiss provided for a stock of sufficient spare parts and manpower at common landing spots to service all members of the Agreement. This eliminated duplication of inventories by each airline at each station.

COSTS SHARED BY MEMBERS WITH RESULTING APPRECIABLE SAVING

Costs, representing the depreciation of capital invested in the spares as well as administration and transport costs of such spares, are shared according to rules set up in the Agreement. The total technical costs of each station are also shared by the members. Savings, as a result of Beneswiss, amount to hundreds of thousands of dollars each year.

The Beneswiss Agreement has been in successful operation for about eight years. Present participants in Beneswiss include KLM, Sabena, Swissair, SAS and Alitalia/LAI.

WIDESPREAD COVERAGE SUCCESSFUL

To simplify use of the agreement and to enable the issuance of changes as necessary, various annexes have been introduced. These annexes, revised twice a year before the International Air Transport Association sessions, mention the stations where pooling is effected, list the spare parts to be available, and state the rules according to which the costs involved are shared by the members.

Covering Europe, Africa, North and South America, and Middle East routes, the Beneswiss Agreement has proved that close technical cooperation between airlines is possible for the benefit of all.

This feature is an activity of the SAE OVERSEAS INFORMATION COMMITTEE, C. G. A. Rosen, chairman

3 SAE NATIONAL MEETINGS

TRANSPORTATION

DIESEL ENGINE

FUELS & LUBRICANTS



T. R. Thoren, general chairman for the three Meetings, receives his boutonniere.

TECHNICAL sessions staged by four of SAE's most important Activities drew more than 1000 members and guests to Cleveland's Hotel Statler November 4–8. Louis B. Seltzer, editor - in - chief of Scripps-Howard Ohio Newspapers, was the featured speaker to address the Transportation, Diesel-Engine, and Fuels & Lubricants Meetings attendants at a joint dinner on the evening of November 6. SAE vice-presidents representing each of the four Activities participating in the three National Meetings were in attendance. They were: S. J. Tompkins (Truck & Bus); Henry Jennings (Transportation & Maintenance); M. R. Bennett (Diesel Engine); and C. J. Livingstone (Fuels & Lubricants).

Set in a background of the most extensive plant-visit program ever fashioned for SAE groups, the three National Meetings brought together some 35 technical papers at 15 separate sessions.

The outside-the-hotel schedule began on the afternoon of the opening day and carried on through four full days. Nine plants in all were opened to the engineers who attended these three National Meetings.

The General Committee for the three National Meetings was headed by T. R. Thoren, while J. A. Newton was directly responsible for the unusual plant-visit program. SAE Cleveland Section participation, developed through its chairman E. J. Manganiello, who was a member of Thoren's General Committee, was active and effective throughout the week.

Other members of the General Committee were: E. K. Brown, A. D. Gilchrist, R. G. Hill, R. A. Pejeau, E. H. Scott, F. X. Sieloff, V. C. Speece, R. F. Steeneck, A. O. Willey, and F. L. Zirbes. Working actively with Cleveland Section Chairman Manganiello were J. H. Dunn, the Section's vice-chairman; J. P. Henson, its secretary, and E. H. Scott, its treasurer.

J. N. Bauman, president of White Motor Co., was toastmaster at the dinner, where Seltzer, who is also editor of the Cleveland press, spoke on the highways of the future.

An outstanding technical event of the week was the exhaustive study of bearing applications for heavy-duty axles which, this year was the L. Ray Buckendale Lecture. Authors of the Lecture and winners of the L. Ray Buckendale Award this year were Robert M. Riblet and Charles M. Kitson, Timken Roller Bearing Co. Presentation of the Award at the time of the Lecture on the evening of November 5—was made by E. P. Lamb, chairman of the L. Ray Buckendale Lecture Board of Award.

Transportation Meeting

OPERATORS and manufacturers joined hands to solve mutual problems and discuss things to come at the SAE National Transportation Meeting, held on November 4–6.

They heard of the future of turbocharged diesel engines where the blower and engine are designed together—the problems of giving good response during acceleration without smoking the engine—controlling engine output as a truck climbs high mountains —and producing high power at low engine speeds.

Starting and running gas and diesel engines in bad weather promoted discussions on multigrade oils and carburetor icing. Good cold starting and hot running oils were compared to the cost of supplementary starting devices such as plug-in heaters, garages, and push trucks. Icing problems and solutions were actually demonstrated at the meeting.

Truck air suspension systems yielded new approaches to the design and operation of the vehicle. Along with "cube" and ground clearance advantages, engineers learned of reduced fatigue requirements due to low transmission of high frequency vibrations. Light metal can now be used where steel used to be the only solution. Better than a 50% decrease in tractor weight is predicted with air suspension.

Maintaining present and new vehicles hangs on the training of

mechanics and specialized instruments for trouble shooting, the members heard. Hydrodynamics, a-c alternators, refrigeration, and injection systems are some of the newer problems facing maintenance men.

Developments in power take-offs, pumps, hoists, dump bodies, winches, and cranes rounded out the program in one of the two panel sessions.

Diesel Engine Meeting

AMONG the technical accomplishments engineers at the SAE National Diesel-Engine Meeting on November 5–6 heard about and discussed were the Fell diesel-mechanical locomotive and the use of "fumigation" to kill smoke and improve diesel performance.

The Fell system—an invention of the British engineer, L. F. R. Fell—makes use of a mechanical transmission in place of the usual electric type.

Extensive tests of the Fell locomotive show that it produces, at all speeds, a considerably greater percentage of its installed power at the drawbar than comparable diesel-electric locomotives.

A prototype locomotive using the Fell system has now rounded out seven years of successful operation. Experience with this locomotive has led to the design of an improved transmission that is to be used in an express-passenger articulated locomotive of 3600 bhp and a mixed traffic locomotive of 1800 bhp.

Fumigation—or the introduction of a portion of the fuel charge of a diesel into the intake manifold in the form of a fine mist—has been under study for some years. These investigations show that it can provide such advantages as reducing smoke, increasing smoke-limited power output, and decreasing specific fuel consumption. At the meeting it was revealed that these benefits can be increased if an apparatus producing a very fine

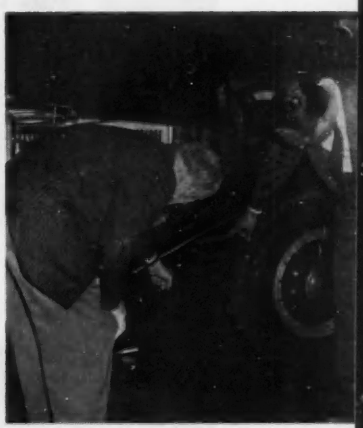
Continued on page 76





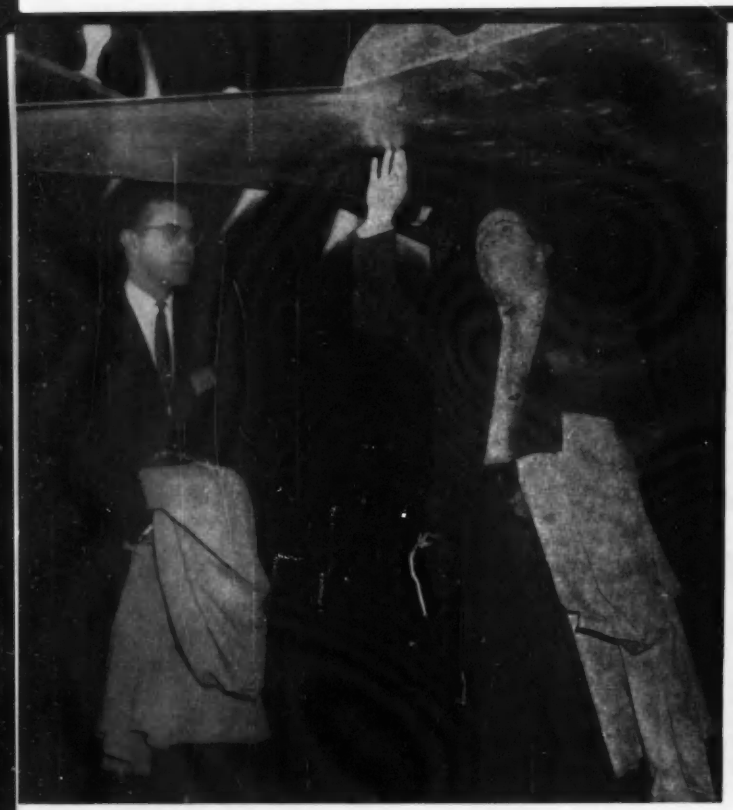




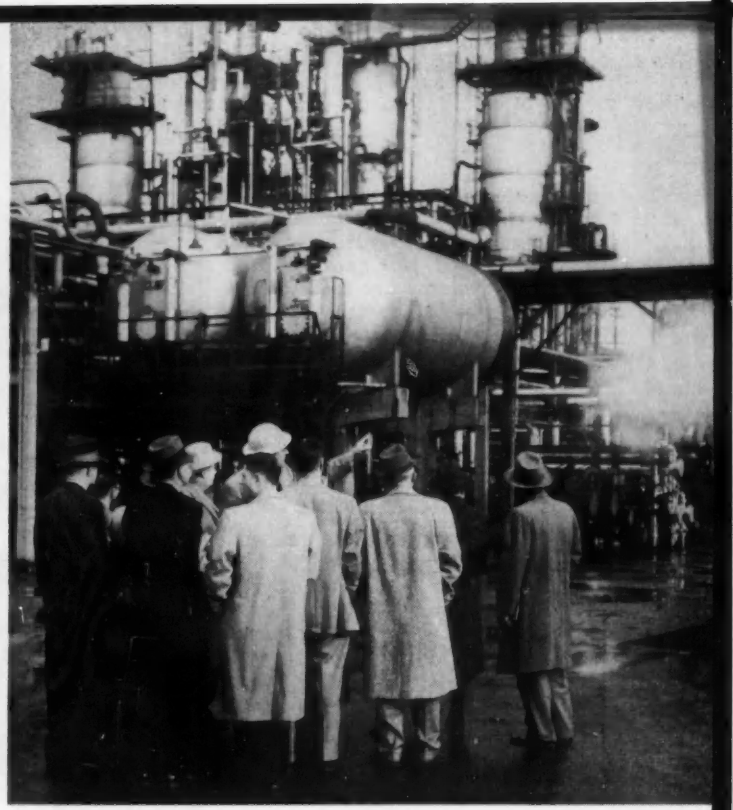




Thompson Products' Auto Album and Aviation Museum, opened its doors on Monday evening to SAE members and guests attending the three Meetings. As the pictures on this page show, all those visiting the Museum had a fine time inspecting the engineering features of the many old cars on display.



NACA



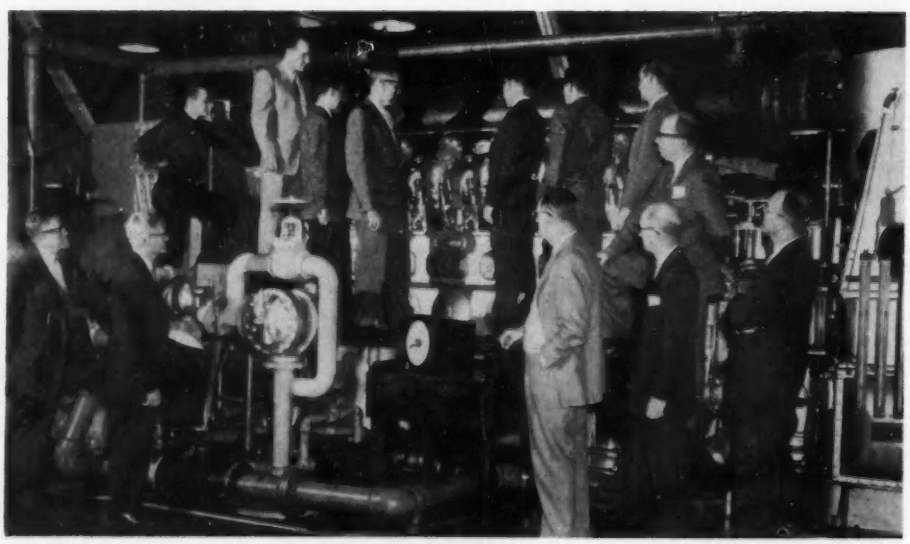
Sohio

Cleveland Plants Visited



Transportation
Diesel Engine
Fuels & Lubricants

NINE plants opened their doors to engineers attending the three National Meetings: Euclid Division, GMC; engine and foundry plants of Ford Motor Co.; Cleveland Diesel Engine Division, GMC; Lubrizol Corp.; Chevrolet Division, GMC; refinery and auto laboratory of Standard Oil Co. (Ohio); Valve Division, Thompson Products, Inc.; Lewis Flight-Propulsion Laboratory, NACA; and White Motor Co. Shown on this page are photographs taken at many of the plants during the visits.



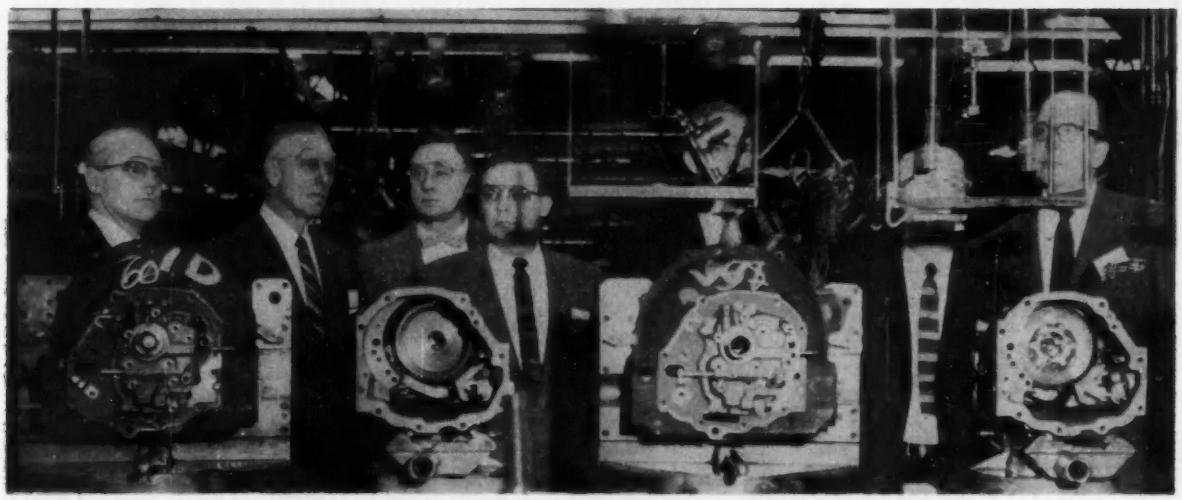
Cleveland Diesel



Lubrizol



White



Chevrolet



Ford



Thompson Products



HORNING MEMORIAL AWARD for 1956 is presented to John M. Campbell (right) by H. W. Best, chairman of the Board of Award, and Mrs. Elsie M. Horning, sponsor of the Award. Campbell, scientific director of the Research Staff, General Motors Corp., received the Award "in recognition of distinguished active service in the field of mutual adaptation of fuels and engines," and for presenting the Horning Memorial Lecture, "Looking Ahead in Fuels for Automotive Transportation." (See pages 41-52 of this issue for the complete lecture.)



Transportation
Diesel Engine
Fuels & Lubricants

Continued from page 73

mist (droplets under 4 microns) is used in place of the previously tried injection nozzles and carburetors, which give rather coarse sprays.

Still to be overcome, however, is the problem of producing this fine a spray in large quantities. Meanwhile, significantly improved performance was reported obtained with inexpensive pneumatic spray nozzles that require only a small amount of low-pressure air for operation.

Fuels & Lubricants Meeting

SPECIFICALLY recorded progress toward better correlation of road and laboratory octane ratings was an important contribution made by the petroleum and car engineers at the Fuels and Lubricants Meeting on November 7 and 8. Recorded also were the results of new techniques for trying to preguess octane requirements as engine compression ratios keep going up.

Nobody pretended to be saying the final word in either of these currently sensitive areas. But quite specific conclusions were hazarded as regards limited phases of the broad problems.

One group of researchers, for example, says that reproducibility of road rating tests on fuels in the 100 to 105 Research octane number range is comparatively good; about as good as on fuels below 100 octane. Another group finds marked differences in road rating characteristics in any given test car between fuels of approximately the same Research octane number . . . and still another group reports that "there is a valid correlation between road antiknock performance and the Research and Motor Laboratory octane ratings."

One research group revealed a new set of equations by which, they said, a very good guess can be made about road octane rating from a combination of laboratory results as to Research and Motor ratings and the hydrocarbon content of the fuel involved. Having tried out the formula, they reported that it predicts accurately oftener on cars whose engines use "regular" fuels than on those using "super" and "premium" fuels.

Another group, also trying to peer into the octane-need future, took three different types of 10/1 compression ratio, 1956 production engines and modified them to produce a 12/1 compression ratio. Then they knock tested them in suburban driving—using a fuel-oil combination which prevented surface ignition or rumble. Results indicate that fuels up to about 105 Research octane number (or about 110-octane road rating) can be rated satisfactorily in 12/1 cars using either Modified Uniontown or Modified Borderline procedures.

Trialkyl phosphines—a new class of phosphorous additives—were reported at the meeting as going a long way toward eliminating deposit-induced surface-ignition, spark-plug fouling, and octane-requirement build up. The most

CHARLES M. KITSON (left) accepts plaque in behalf of Robert M. Riblet and himself, for presenting the 1957 L. Ray Buckendale Lecture, from E. P. Lamb, chairman of the L. Ray Buckendale Lecture Committee. Kitson, assistant chief engineer, Automotive Division, Timken Roller Bearing Co., presented the lecture, "Bearing Applications for Heavy-Duty Axles," in the absence of his colecturer. Riblet, chief engineer, Automotive Division of Timken was in Europe at the time of presentation. (Complete lecture will be published in 1958 SAE Transactions.)



surprising thing about these particular new additives, it was said, is that they actually *reduce* octane requirement . . . instead of increasing it as do other phosphorous additives.

The Horning Memorial Lecture, presented this year by Horning Award Winner John M. Campbell, General Motors Corp., appears in full beginning on page 41 of this issue. Presentation of the Award was made to Campbell (at a luncheon during the Fuels & Lubricants Meeting) by Mrs. Elsie M. Horning and H. W. Best, chairman of the Horning Board of Award.



TOASTMASTER J. N. Bauman (left) and speaker Louis B. Seltzer discuss the joint dinner program. Seltzer spoke on the need for reevaluation in view of Sputnik I and II.



CLEVELAND Section Chairman E. J. Manganiello and Meeting General Chairman T. R. Thoren meet with SAE President W. Paul Eddy at the reception before the joint dinner.



SAE VICE-PRESIDENTS M. R. Bennett (left), C. J. Livingstone, and Henry Jennings (right) compare notes on the triple National Meeting before the joint dinner.

Rambling . . .

THROUGH THE SECTIONS

FILMS, IBM, racing and sports cars, and TV have been fall highlights for the Sections . . . in addition to several symposium programs. Movies were shown at the **NORTHWEST, TWIN CITY,** and **NEW ENGLAND SECTIONS** . . . the **Northwest Section,** at its October meeting, was shown a research film on the new Ryan X-13 Airplane in addition to a presentation by Homer T. Seale. Seale, president of Sealco Brake Co., spoke on "Brake Balance Between Axles." An abridgment of this paper will appear in a future issue of the Journal.

The October 16 meeting of the **Twin City Section** included a car racing film, "Pioneer of Progress," as well as Paul O'Shea speaking on "Sports Cars." Appearing below are, left to right, Paul O'Shea, sports car driver and consulting engineer, Daimler-Benz of North America; D. D. Hornbeck, Section chairman; and W. E. Schwieder, Meetings chairman, posed with a Mercedes-Benz 300SL racing sports car. Several sports cars were on display at the meeting.



A film on the U. S. Satellite Program and a paper entitled "The Principles of Earth Moving with Scraper Equipment" were featured November 12 at the **New England Section** meeting. Dan K. Heiple, chief field service engineer, LeTourneau-Westinghouse Co., presented the paper telling Section members that although the price of everything going into modern highway construction has risen substantially in the past decade, equipment productivity changes and ingenuity of the contractor have been such as to offset a trend to higher excavation costs. . . . Coffee Speaker Professor Jonathan Karis of the University of New Hampshire introduced the film on the U. S. Satellite Program, which included a discussion and description of the satellite program by members of the Smithsonian Astrophysical Laboratory and the Office of Naval Research. Following the film was a discussion of the current topic, "The Status of Science and the Quality of Science Education in the U. S. as Compared to the U. S. S. R."



Frank E. Christofferson (left), manager of the Flight Test Division, McDonnell Aircraft Corp., is greeted by Harold Hertenstein (right), at the October 8 meeting of the **ST. LOUIS SECTION.** . . . Christofferson was the guest speaker of the meeting, addressing the group on "Flight Testing." Hertenstein is Section vice-chairman of Aircraft Activities.



THE DAYTON and **INDIANA SECTIONS** had speakers from IBM. . . . Donald G. Thoroman (right) is shown addressing the **Dayton Section** at the November 5 meeting. Seated are, left, J. H. Overwein, Dayton Section chairman, and, right, J. I. Covert, Section treasurer. Thoroman, an applied science representative with IBM, presented "The Electronic Computer—Newest Engineering Tool." J. S. Fouch, of IBM's Indianapolis office presented "Engineers, Computers, and Time" at the October 17 meeting of the **Indiana Section.**

Fouch briefly traced the history of computers from the invention of the abacus. He stated that there are currently more than 100 firms offering computers, and that IBM alone offers 11 models. These manufacturers offer a consulting service which analyzes customers' problems and recommends computers best suited to their needs. . . . Following that talk a discussion was offered by R. E. Henderson, superintendent of the applied physics group, Allison Division, General Motors Corp. Henderson stated that the computer has created a new job, that of the programmer. He stressed that programming of problems must be specific; that the computer cannot think; its answers are only as reasonable as the information provided to it.

RACING, sports, and small cars were the topic for the **MID-MICHIGAN** and **MID-CONTINENT SECTIONS** meetings, as well as for the Twin City Section program mentioned above.

"The design of motor cars is controlled by the environment in which they must operate," so began Harold Drew, chief engineer of General Motors Corp. Overseas Operations, in his talk on the subject of "Small Cars" before 245 members of the **Mid-Michigan Section,** October 7.

"Cars must adapt themselves to their environment, the economic factors being far more important than the physical." Drawing a comparison with the survival of animal species, Drew pointed out that large cars have not survived in some areas, while small cars have struggled for existence in others. The multiple-car family, brought about by an expanding suburbia, and an increasing standard of living, has created an environment in the U. S. in which the small car can thrive. He quoted a recent survey which showed that 42% of all small-car owners also own another car.

Guest speaker, Harold Drew, foreground, is shown discussing the GMC's Opel car with, left to right, Louis L. Otto, Section vice-chairman; Philip Zeigler, Section chairman; Kenneth Wilcox; and Tom R. Tompkins, Oldsmobile Division, GMC.

Drew emphasized his conviction that the small-car market will be superimposed upon the existing market, not replace it. . . . In answering questions which followed the address, Drew told the audience that:

- American motorists' driving habits are flexible enough to shift from the super-automatic American car to the rather standard operating controls of the small import. For this reason, he does not foresee any immediate changes in the imported article toward such devices as torque converters.

- Considerable variation exists between the "small car" field—from "minimum transportation" of the Volkswagen to more completely equipped models of significantly larger size. Drew called the VW a "most brilliant example of automobile design with one exception—the Model T. It put personal transportation within the reach of the German people."

- Cars like the new GM imports—the Vauxhall and Opel—are designed for people who want more than minimum transportation but still like the small car. In cars of this category, a conventional powerplant, and drive line arrangement, still proved most satisfactory.

- Import taxes on components are much heavier than on complete vehicles. This restricts practically all U. S. assembly of foreign made components and was the major factor in VW abandoning plans for an assembly plant in New Jersey.

The Mid-Michigan meeting was highlighted by a display of some 16 foreign cars, ranging in size and cost from the Isetta to the Mercedes-Benz 220S. A statistical summary of all the cars furnished a guide to the exhibits.

Preliminary to the speaker, the Section presented SAE banners to the two Student Branches within its territory . . . Michigan State University and General Motors Institute.



THE Mid-Continent Section launched its 1957–58 season on September 27 with Leonard Williams, project engineer, Boeing Airplane Co. as guest speaker. (See page 84 for photo.) Williams presented a paper on "Gas Turbine Competition at Indianapolis," reporting that Boeing has developed a turbine powerplant which could be installed in a racing car chassis. In Williams' opinion, this combination of engine and car would not only be a serious threat in the Annual 500 Mile Race at Indianapolis, but would also stand a very real chance of winning. . . . Below is pictured a sample of the material used in the talk, the Boeing Model 502-8C, 175 hp turbine, installed in a Kurtis 3,000 series chassis. This car made a demonstration run at Indianapolis, just before the 1955 race. . . . The January issue of the Journal will feature a digest of this paper.



The second meeting of the Mid-Continent Section was held October 25, and featured a panel of 4 speakers on the general topic, "Problems and Benefits of LPG for Automotive Applications." Members of the panel were: R. E. Witte, regional engineer, International Harvester Co., discussing the design, performance, and manufacture of LPG engines; F. E. Selim, manager of LPG Motor Fuels, Phillips Petroleum Co., discussing the use of LPG fuel for automobiles and trucks; and C. M. Floyd, senior research engineer, Humble Oil and Refining Co., telling of the role that lubricants play in LPG equipment. The vehicle operator was represented at the symposium by Bob Parham, superintendent of maintenance, Central Oklahoma Milk Producers' Association.

Following remarks prepared by each panel member, a lengthy question and answer period was held. The moderator, and sometimes referee, for the symposium was Warren A. Brown, manager, lubricant sales and technical services, Champlin Oil & Refining Co. . . . Questions causing the most controversy were those concerning the type and grade of lubricating oil to be used in LPG engines.

Rambling . . .

THROUGH THE SECTIONS

CARS, old and young, were "on stage" at the TV program of the **PITTSBURGH SECTION**, and the November meeting of the **SOUTHERN NEW ENGLAND SECTION** . . . the first TV show, September 27, was brightened by shots of several vintage automobiles. . . . Section members Fred Haller and Watson Adams were on hand, Haller with his 1911 Chalmers which chugged nicely before the cameras, and Adams with his 1936 Cord. A 1922 Model T Phaeton and 1924 Rolls Royce roadster were also featured. Murray Fahnestock introduced, and R. J. S. Pigott presented the first show. Pigott described the birth of the early automobile, then described chronologically the evolution of major basic changes in design . . . such as the change from tiller to steering wheel, and the hand crank to the self-starter.

The TV series consists of 13 one-hour shows presented on Fridays, through December, at 7:30 to 8:00 pm, on Pittsburgh's WQED-TV. The last show will be Dec. 27. Major phases of the operation of an automobile, of particular interest to the owner, are being presented in a non-technical way. Many props to illustrate the discussions are being used. (For program schedule see page 104 of the November Journal.)

October 22 meeting of the **Pittsburgh Section** featured guest speaker Eugene Gore of the Diesel Engine Corp. presenting a talk entitled "The Air Cooled Diesel Engine—Advantages and Applications." Gore described the principal design features of the Deutz high speed, 4-cycle, air cooled diesel engine, and discussed its application advantages. Phillip Adolf, also of Diesel Engine Corp., was present and participated in the discussion following the presentation.

FEATURED "on stage" at the **Southern New England Section** November 13 meeting was a demonstration hard top convertible used by the speaker, Joseph C. Johnson in his presentation entitled "Watt-Muscles in the Modern Automobile." Johnson traced for the group the development of the automobile electrical system from its simple beginning of supplying ignition to the fuel mixture . . . to its present position of prominence where the vehicle cannot be started, steered, shifted—or in some cases entered—if the electrical system is inoperative.

OTHER panel-type sessions were held at the **NORTHERN CALIFORNIA** and **BALTIMORE SECTION** meetings . . . the Program Committee of the **Northern California Section** is planning several panel-type meetings for the Section year, due to the enthusiastic reception of the September 25 meeting. . . . Seven panel members discussed "What is Your Opinion of the Performance of Multigraded Motor Oils?" Panel members were: John Miller, California Research Corp.; S. E. Ellerbe, Ethyl Corp.; E. Poole, Waukesha Motor Co.; T. Ivie, Murphy Buick; Leigh Abell, Pacific Gas and Electric Co.; and I. M. Harlow, Tidewater Oil Co. . . . October meeting for the Section was a Diesel Meeting with Henry M. Hirvo, supervisor of product engineering, Enterprise Division, General Metals Corp., presenting a paper on "Seventeen Inch Bore V-16 Diesel."



The first TV show of the Pittsburgh Section . . . showing the 1911 Chalmers owned by Fred Haller (left), Murray Fahnestock, with microphone, and R. J. S. Pigott, moderator of the first program.

Baltimore Section's November meeting included a Diesel Engine Symposium, following a field trip to the U. S. Naval Air Test Center, Patuxent River, Md.

The Baltimore Section, composed of a very diversified membership, has had the problem of arranging programs which are of general interest and still of technical value to those engineers with particular specialties. In the past the Section divided the meetings equally between the various activities within the group, but with increased membership and increased activities, a re-evaluation of the program seemed to be necessary. The Section's solution was to initiate a seminar or symposium-type meeting, utilizing several speakers and several aspects of a central subject. . . . This provides a program of interest to engineers from more than one activity . . . and goes further toward common ground for discussing and solving the problems.



L. M. Forbush, speaker at the October 8 **MOHAWK - HUDSON** meeting, appears in the middle with John B. James (left), Section vice-chairman, and Perle E. Kezer (right), Section chairman.

Forbush of GMC's Vehicle Development Group gave a quick, interesting statement of GMC's engineering organization, as an incidental to his talk on "Automotive Design Trends." He said:

"Each General Motors *Production* Division has its own engineering group, responsible for engineering *its* product, working on the immediate problems of production, model changeover and the like.

"For long-range development work, for assistance to the Divisions and for special projects which management feels can be handled more effectively by this means, GM maintains a *central* Engineering Staff.

"The engineering work done by this Staff is carried on by four Development Groups . . . Vehicle Development, Structure and Suspension Development, Transmission Development, and Power Development. (The Vehicle Development Group is subdivided into a Passenger Car Section and an Automotive Ordnance Section.)

"These semi-independent Groups investigate vehicle components and overall vehicle designs as indicated by the Group names. Some of the so-called 'dream cars' have been developed in cooperation with designers from GM's Styling Division. In addition, several vehicles now in production abroad by GM Overseas Divisions were largely designed by the Vehicle Development Group."

THE October meeting of the **ATLANTA SECTION** featured George Kalember of Lockheed Aircraft Corp., discussing the new "Jetstar" plane . . . a 10-passenger, 4-engine, 500 mph class jet transport. (See page 108 for technical digest of the paper.) "Improvements in Motor Fuels" was the topic of the November Atlanta Section meeting, with guest speaker Walter G. Ainsley.



Nicholas Buchanan, left, 1957–58 **NORTHERN CALIFORNIA SECTION** Chairman, is shown presenting a Past-Chairman Certificate to Elvin B. Lien, 1956–57 Section chairman. Buchanan is with General Petroleum Corp., and Lien with Union Oil Co. of California.

MILWAUKEE SECTION presented five Certificates of Membership to engineers at the November 1 meeting. . . . 25-year Certificates of Membership were presented to E. R. Rutenber and C. L. Coughlin. Cited for 35-years of membership were Walter Ferris, F. T. Irgens, and Theodore M. Robie. Of special note is the fact that Ferris, recipient of a 35-year certificate, was born in 1868!

D. B. McFadden, regional service manager, White Motor Co., was guest speaker at the **KANSAS CITY SECTION** meeting October 7, addressing the group on "Keeping Dirt Out and Getting Heat Out of Engines."





Past chairmen of **METROPOLITAN SECTION** entertained Judy McCormick on October 15 at the Savoy-Plaza in New York City, upon her retirement from the SAE Staff. Seated, left to right, with terms of Chairmanship, are Charles E. Chambliss, Jr., 1956–57; Leslie Peat, 1952–53; John A. C. Warner, SAE Secretary and General Manager, the "Sweetheart of SAE," who received a charm bracelet from "her boys;" Edward F. Lowe, 1927–28; Frederick K. Glynn, 1926–27; E. N. Hatch, 1950–51; George A. Round, 1929–30; and Sydney G. Tilden, Jr., chairman of the Committee on Arrangements. Standing, in the same order, are Neil P. Flynn, 1953–54; John F. Creamer, 1931–32; Rudolph F. Gagg, 1940–41; Robert M. Cokinda, 1957–58; Clayton Farris, 1941–42; Sydney G. Tilden, Sr., 1937–38; Richard Cregar, 1949–50; Theodore L. Preble, 1939–40; and Lewis F. Moody, Jr., 1954–55.

Detroit Section Tours New U. of M. Labs

IF research is a mirror of the future, then the October 15 tour for the **DETROIT SECTION** through the new engineering laboratories of the University of Michigan, Ann Arbor, provided a glimpse of things to come. The multimillion dollar development is a long range program aimed at meeting industry's expanding needs in engineering training and research.

Detroit Section Members at Dedication

At the dedication ceremonies on October 15 of the University of Michigan's new Automotive Engineering and Aeronautical Engineering Laboratories, the SAE Detroit group toured the newly completed labs as well as the Phoenix Memorial Laboratory including the Ford Nuclear Reactor. This was an unusual and informative opportunity to view these noted projects first-hand.

Viewed at the U. of M.'s Automotive Engineering laboratory were 19 soundproofed test cells, three of which can handle gas turbine engines. The 400-ft-long structure also contains a structure section where large areas hold automotive bodies and chassis.

In the Aeronautical Laboratory the engineers viewed the three units: the aerodynamics lab, the propulsion lab, and the pumping station.

Three wind tunnels are located in the aerodynamics unit, one low-speed tunnel which forms a 336-ft-long loop outside the lab and a 7-ft-high test area inside the building, and two supersonic wind tunnels with facility for wind velocities from 850 to 1,700 mph. Currently under study in these tunnels is the ability of supersonic jets blown out the sides of missiles to control the missile's flight in the thin air 200,000 ft in the sky. Other studies deal with more conventional control surfaces, their angles of attack and similar features.

In the propulsion lab, researchers are concerned with colliding shock waves, gases burning at very high pressures, the flow of gases through turbines, and other phenomena relating to powered flight. The pumping station contains equipment for producing the high pressure required, evacuating the vacuum tanks, and performing other chores.

U. of M.'s plans for the future include a fluids laboratory, a materials, metallurgy and structures laboratory, a highway engineering laboratory, a sanitary engineering laboratory, class room and office building, auditorium and library.

Zeder Main Speaker

Main speaker at the technical session which followed the tour and dinner was **JAMES C. ZEDER**, vice-president,



Visitors examine a Chevrolet engine in one of the 19 test cells in U. of M.'s new Automotive Engineering Laboratory. A cooling tower is located in the center of the photo. Displays of products and pieces of equipment for the dedication were donated by industry.



A member of the Upper Atmosphere Research Group of the Aeronautical Engineering Laboratory explains how spheres, such as the one in the center of the photograph, are filled with instruments, placed in Nike-Cajun rockets, and ejected at prescribed altitudes.

engineering—special advisor to president, Chrysler Corp. (The text of this presentation will appear in the January, 1958, issue of SAE Journal.)

Acting Dean of Engineering Stephen A. Attwood welcomed the Detroit Section members in the name of the University. He described plans for the new facilities under the heading of "Engineering and the North Campus." Attwood has had extensive contact with industry, particularly with research in the electrical field.

Cited by the U. of M.

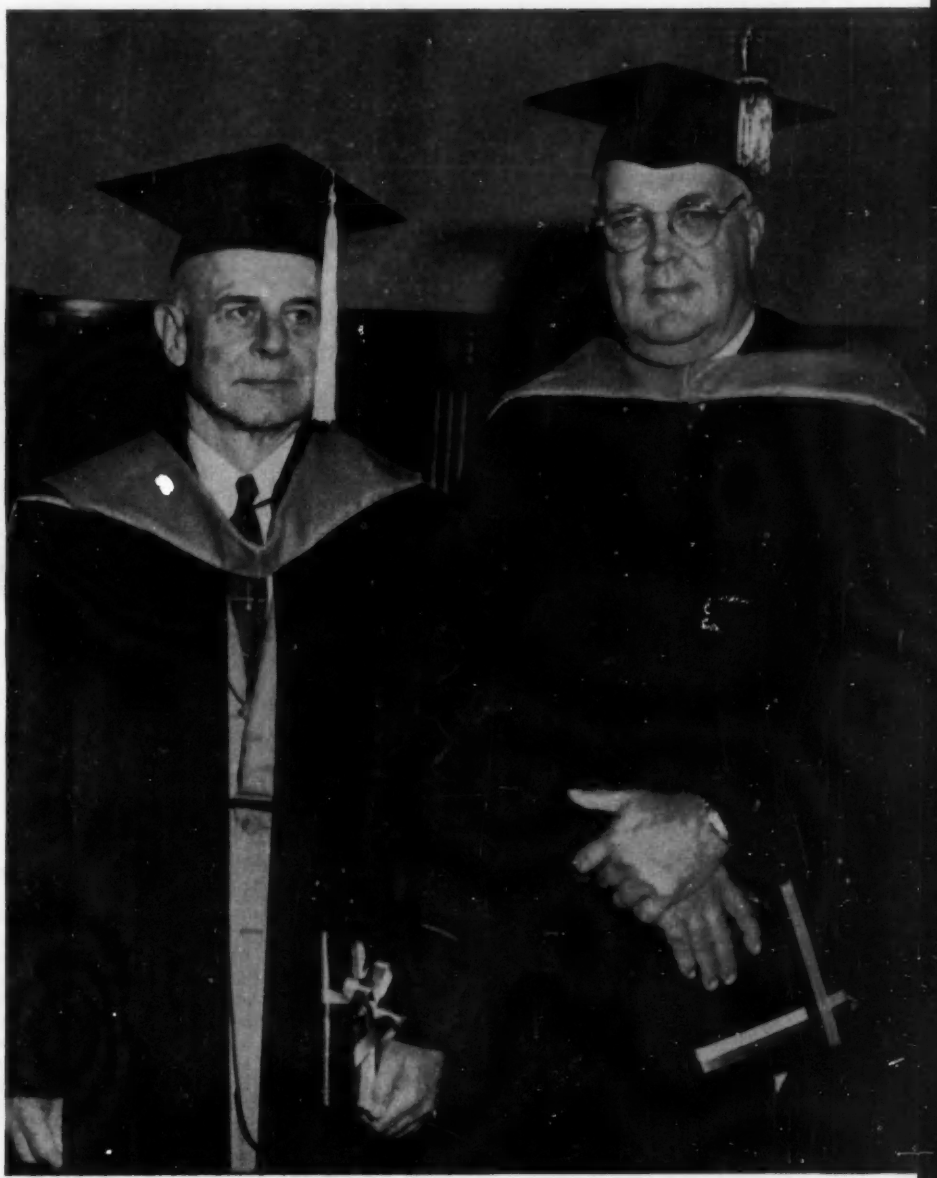
Among the guests honored during the University of Michigan dedication ceremonies were many SAE members . . . honorary degrees of Doctor of Engineering were conferred upon James C. Zeder and **JAMES H. DOOLITTLE.** (See photograph at right.)

WALTER E. LAY, professor of Mechanical Engineering at the University of Michigan, was presented with a bust of himself by his former students. (See page 90 for photo.)

Distinguished Alumni Awards

Of the 34 recipients of citations to distinguished alumni were the following SAE members: Harold J. Chalk, Ethyl Corp.; Charles C. Dybvig, Dana Corp.; Lyman C. Fisher, U. S. Naval Ordnance Laboratory; Charles W. Frederick, Detroit Diesel Div., General Motors Corp.; Donald N. Frey, Ford Motor Co.; Jerry M. Gruitch, ACF Industries; Mathew C. Haddon, California Div., Lockheed Aircraft Corp.; Harry Hawkins, Saginaw Steering Gear Div., General Motors Corp.; Charles H. King, Clark Equipment Co.; William A. McKinley, Midland Steel Corp.; Robert W. Middlewood, Marietta Div., Lockheed Aircraft Corp.; Joseph M. Miller, Standard Oil Co.; Herbert L. Misch, Mercury Div., Ford Motor Co.; Clayton E. Patterson, Ford Motor Co.; Ray C. Sackett, Society of Automotive Engineers, Inc.; Arthur A. Schupp, Farmers and Manufacturers Beet Sugar Association; Harold R. Steding, Chrysler Corp.; Harold A. Strickland, Jr., Industrial Electronics Div., General Electric Co.; Lyle A. Walsh, General Motors Corp.; Leo A. Weiss, AVIEN, Inc.; Richard J. Williams, American Metal Products Co.

Also cited for making possible the automotive and aeronautical laboratories were the following SAEr's: Darl F. Caris, General Motors Corp.; Harold R. Steding, Chrysler Corp.; Paul C. Ackerman, Chrysler Corp.; Wallace S. Berry, American Motors Corp.; C. A. Chayne, General Motors Corp.; Harry E. Chesebrough, Chrysler Corp.; Carl T. Doman, Ford Motor Co.; Charles C. Dybvig, Dana Corp.; Lawrence R. Hafstad, General Motors Corp.; Charles H. King, Clark Equipment Co.; Andrew A. Kucher, Ford Motor Co.; Earle S. MacPherson, Ford Motor Co.; C. L. McCuen, General Motors Corp.; B. David McIntyre, Monroe Auto Equipment Co.; Herbert L. Misch, Mercury Div., Ford Motor Co.; Clayton E. Patterson, Ford Motor Co.; George W. Romney, American Motors Corp.; Arthur A. [illegible], Farmers and Manufacturers [illegible] Beet Association; James C. Zeder, Chrysler Corp.



HONORARY DOCTOR OF ENGINEERING DEGREES were conferred by the University of Michigan on two distinguished SAE members at the time of the dedication ceremonies of the University's new engineering laboratories on October 15: **JAMES H. DOOLITTLE** (left), vice-president of Shell Oil Co., and **JAMES C. ZEDER** (right), vice-president—engineering, special advisor to president, Chrysler Corp.

The Detroit meeting was planned and sponsored by the Section's Passenger Car Activity, **J. P. CHARLES,** vice-chairman. Professors **W. H. GRAVES** and **J. A. BOLT,** of the Automotive Engineering School, U. of M., assisted in arranging the program.

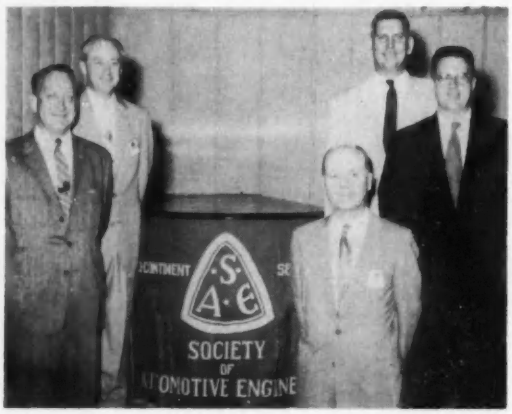
from other SECTION CAMERAS



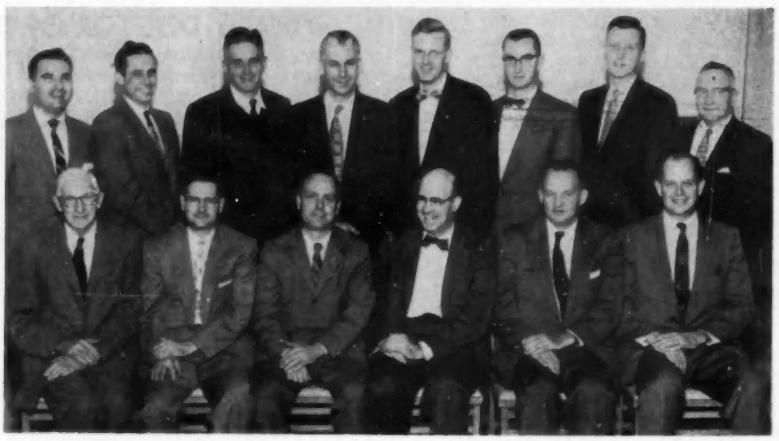
THE SOUTH TEXAS GROUP was addressed by Jack Howard of the Humble Oil and Refining Co. at their October meeting. The title of his talk was "The Magic Barrel," in which the various commercial products manufactured from petro-chemicals were discussed. At left Howard is shown as he describes a type of tubing made from petro-chemicals.



TEXAS GULF COAST SECTION officers, left to right, W. B. Tilden, vice-chairman; Charles Goff, secretary; and R. Frank Wilson, chairman, join SAE Past-President C. G. A. Rosen and Frank Suess, Section vice-chairman for Fuels and Lubricants Activity, at the Section's October meeting. Rosen presented a paper on "Looking Into the Crystal Ball on Future Vehicle Powerplants."



MID-CONTINENT SECTION officers and guest speaker at the September meeting appear, left-above, Idan E. Flaa, secretary; left-below, Frank DeVore, Section chairman; right-above, Warren L. Thompson, vice-chairman; right-middle, Leonard H. Williams, speaker from Boeing Airplane Co.; right-below, Walter J. Ewbank, treasurer.



PITTSBURGH SECTION Governing Board members, standing left to right: C. D. Auria, arrangements chairman; D. W. Gow, finance chairman; M. J. Boegel, field editor; C. L. Wolfe, past-chairman; R. S. Spindt, student chairman; W. C. Weltman, Jr., membership chairman; R. M. Thurston, publicity chairman; and N. T. Brenner, meetings chairman. Seated, left to right: M. Fahnestock, archivist and TV chairman; H. A. Bigley, Jr., Secretary; R. P. Gilmartin, Section chairman, Hollister Moore, manager of SAE Sections and Membership Division; A. E. Dible, vice-chairman; O. B. Rosstead, Jr., treasurer.

SAE National Meetings

January 13-17
Annual Meeting and Engineering Display, The Sheraton-Cadillac and Statler Hotels, Detroit, Mich.

March 4-6
Passenger Car, Body and Materials Meeting, Sheraton-Cadillac Hotel, Detroit, Mich.

March 31-April 2
Production Meeting and Forum, The Drake, Chicago, Ill.

April 8-11
Aeronautic Meeting, Aeronautic Production Forum, and Aircraft Engineering Display, Hotel Commodore, N. Y., N. Y.

June 8-13
Summer Meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.

August 11-14
West Coast Meeting, Ambassador, Los Angeles, Calif.

September 8-11
Farm, Construction and Industry Machinery, Production Forum and Engineering Display, Milwaukee Auditorium, Milwaukee, Wis.

September 29-October 3
Aeronautic Meeting, Aircraft Production Forum, and Engineering Display, Ambassador, Los Angeles, Calif.

October 20-22
Transportation Meeting, Lord Baltimore Hotel, Baltimore, Md.

October 22-24
Diesel Engine Meeting, Lord Baltimore Hotel, Baltimore, Md.

November 5-6
Fuels and Lubricants Meeting, The Mayo, Tulsa, Okla.

SAE Section Meetings . . .

ALBERTA

December 13 . . . Wing Commander Fred Durant, Royal Canadian Air Force.—"Jet Power" as used in the planes of the Royal Canadian Air Force. Royal Room, Royal Hotel, Second Street West & Eighth Avenue, Calgary, Alberta, Canada.

BUFFALO

December 16 . . . Dr. Seville Chapman, Cornell Aeronautical Laboratory.—"Scientific Problems in the International Geophysical Year." Hotel Sheraton, Delaware near North, Buffalo. Dinner 7:00 p.m. Meeting 8:00 p.m.

INDIANA

December 12 . . . Kurt Beier, vice president in charge of engineering and research, Schwitzer Corp.—"Diesel Engine Turbo Chargers." Indianapolis Naval Armory Mess, White River at 30th Street. Cocktail Hour 6:30 p.m. Meeting 8:00 p.m.

METROPOLITAN

December 19 . . . Diesel Engines Activity Meeting. Dr. N. H. Haas, chief engineer, diesel section, Continental Aviation & Engineering Corp.—"AVDS-1790 Development." Engineering Societies Building, 29 West 39th Street, New York, N. Y. Meeting 7:45 p.m.

January 9 . . . Passenger Car & Body Dinner-Meeting. O. K. Kelley, chief engineer, Buick Motor Division, GMC. "Torque Converters for the Future." Brass Rail Restaurant, Fifth Avenue between 43rd & 44th Streets. Cocktails 5:30 p.m. Dinner 6:30 p.m. Meeting 7:45 p.m.

NEW ENGLAND

January 7 . . . Commander Norman L. Martinson, director of transportation, Bureau of Yards & Docks, U. S. Navy, Washington, D.C. M.I.T. Faculty Club. Dinner 7:00 p.m. Meeting 8:00 p.m.

PHILADELPHIA

December 11 . . . Gordon P. Larson, Oxy-Catalyst, Inc.—"Air Pollution." Engineers Club, 1317 Spruce Street, Philadelphia. Dinner 6:30 p.m. Meet-7:45 p.m.

January 8 . . . Rear Admiral John T. Hayward, research and development staff, U. S. Navy, Office of Chief of Naval Operations, Washington, D. C.—"Manned Aircraft Versus Guided Missiles." The Engineers' Club, 1317 Spruce Street, Philadelphia. Dinner 6:30. Meeting 7:45. Special Feature: Joint Meeting with Institute of the Aeronautical Sciences & the American Helicopter Society.

PITTSBURGH

Fridays from 7:30–8:00 p.m. through December 20. "Your Auto & You." Metropolitan Pittsburgh WQED-TV, Channel 13.

SOUTHERN NEW ENGLAND

December 12 . . . Elwood L. Byrkett, assistant manager, Sheffield Corp.—"The Science of Measurement." Hartford Golf Club, Hartford. Dinner 6:45 p.m. Meeting 8:00 p.m.

SOUTHERN CALIFORNIA

December 9 . . . M. C. Horine, consultant, and Bruno Loeffler, executive engineer, Mack Trucks, Inc.—"Accomplishments and Possibilities of Turbo Charged Automotive Diesels." Rodger Young Auditorium, Los Angeles. Dinner 6:30. Meeting 8:00 p.m. Coffee Speaker: Sam Hanks.

TEXAS GULF COAST

December 13 . . . Plant visit to Cameron Iron Works. Robinwood Inn Lodge, 7611 Katy Road. Dinner 6:45. Meeting 7:30.

WILLIAMSPORT

January 6 . . . M. C. G. Schelly, managing director, Do All Company.—"The Story of Measurement." Williamsport High School Auditorium, Williamsport. Dinner 6:45 p.m. Meeting 8:00 p.m. Special Feature: Large display on measuring equipment.

1958 Annual Meeting and Engineering Display

Jan. 13-17, 1958

Sheraton-Cadillac Hotel *Hotel Statler*

Detroit, Mich.

Over **60 technical** papers in 27 sessions

Engineering Display—Sheraton-Cadillac, Jan. 13-17

1958 Annual Meeting Dinner—Detroit Masonic Temple

Presidential Address—Tuesday, Jan. 14
Annual business session announcing election of 1958 officers, presentation of life membership, presentation of Annual Report

Sessions Will Cover—

Passenger Cars—
new air suspensions—the small car and the American market—noise reduction—fuels and lubricants—body styling—

Report from Overseas—
production methods—the Citroen and Daimler-Benz—

Materials—
solid state physics—materials of the future—plating improvements—

Transportation—
better truck ride—truck performance predictions—fleet maintenance problems—

Aviation—
jet engine and bearing problems—bearings and lubricants for small electric motors—applying Niobium to jet engines—economics of helicopters, commercial and executive—jet transport operations—

Also—
free piston engine research and design by computer—effects of radiation on diesel fuel and combustion—studies in exhaust gas composition—farm tractor performance—

Ide Contributes Aero Reference Data

SAE is indebted to John Jay Ide, consultant to the chairman of NACA, and member of the SAE Aircraft Activity Committee, for several important recent reference documents. At the request of SAE's Overseas Information Committee, Ide brought from the International Aeronautical Exposition in Paris last Spring the following documents (now available for member inspection at SAE headquarters):

- French Aircraft and Engine Companies—Les Sociétés de Construction Aéronautique (in French)

Details history, present organization, plants, key personnel, total personnel, post World War II production, present production, and prototype aircraft of French aircraft and engine companies.

- Aircraft and Engines—Le Matériel Aéronautique (in French and English)

Illustrated data sheets of French aircraft and engines are listed alphabetically by maker.

- French Aeronautical Industry—L'Industrie Aéronautique Francaise (in French)

Summary of French aeronautical development including charts showing past and present production of all aircraft makers, present production of missile and engine makers, and prototype aircraft flown in the last two years.

- Official Catalogue of the 1957 Paris International Aeronautical Exposition (in French)—including supporting technical supplements of equipment displayed and the organization of French aviation.

McCarthy and Van Wicklin Receive 1957 Henry Ford Memorial Award

THE winners of the 1957 Henry Ford Memorial Award are W. A. Van Wicklin, Jr., principal resident engineer, engineering staff, Ford Motor Co., and William E. McCarthy, supervisor, simulation and correlation unit, Ford Motor Co.

At Detroit Section's October 28 meeting, they were presented with the award for their paper entitled: "Hydraulic Power Steering—Effects on Valve Characteristics and Steering Wheel Inertia."

The Award was established by Detroit Section and consists of a certificate of merit and a cash prize. Those eligible include all SAE members under 33 years of age who are authors of original papers presented or suitable for presentation at an SAE meeting. The content of competing papers is limited to subjects related to automotive ground vehicles.



William E. McCarthy (left) and W. A. Van Wicklin, Jr. (middle) are shown receiving the Henry Ford Memorial Award from Detroit Section Chairman Milton J. Kittler (right).

Randall Is Winner of 1957 Russell S. Springer Award



RICHARD A. RANDALL, senior research engineer, General Motors Research Staff, is the 1957 winner of the Russell S. Springer Award. He received the award October 28 at a meeting of the Detroit Section.

Randall presented his paper, "Automotive Fuel Pumps—A Fundamental Study of Their Performance," at the SAE Summer Meeting, June 4, 1956. It appeared in the 1957 SAE Transactions.

The Springer Award is presented annually by the SAE to the youngest member—33 years of age or under—whose paper is published in SAE Transactions in the year for which the award is made. Established by the SAE Council in 1954, the award is the result of a $5000 bequest to the Society by the late Russell S. Springer and consists of $100 in cash and a certificate noting its occasion and purpose.

Richard A. Randall (left) receives the Springer Award from Detroit Section Chairman Milton J. Kittler at the October 28 Section meeting.

About SAE



Gurski | Cummins | Brown | Kropf | Caserio



Forester | Compton | Farnsworth | Scheutzow | Prior



Bissell | Firth | Thill | Gordon | Flanigen

JOSEPH GURSKI has been named manager, Chemical and Metallurgical Laboratory, manufacturing services, Ford Motor Co. He has been with the company for 23 years, and most recently was assistant manager, process development department, Manufacturing Staff of Ford.

Gurski now serves as chairman of the SAE Nonferrous Metals Committee and, in 1956, held the distinction of being chairman simultaneously of the Nonferrous Metals Committee and the Iron and Steel Technical Committee.

CLESSIE L. CUMMINS has retired as honorary chairman of the board and as a director of Cummins Engine Co., Inc. Cummins founded the company which bears his name in 1919 and was its president from 1919 to 1947. He served as chairman of the board from 1947–1951, as honorary chairman of the board since that date, and has been a director of the company since its founding. In 1943, during World War II, he was director of diesel production, War Production Board.

Thirty-eight years ago he built his first diesel under license, and in 1931 he developed the first diesel race car to run in the famed "Indianapolis 500."

In the future, Cummins will devote his full time to Centco, a research company which he has organized at Sausalito, Calif.

WILLIAM HUNTER BROWN has joined Vard, Inc., as project engineer. Formerly he was design engineer, Hamilton Standard Division, United Aircraft Corp.

RICHARD B. KROPF has been appointed supervisor of development activities in the automotive industry, Detroit technical field section, International Nickel Co., Inc. Formerly he was a metallurgical engineer with the company.

E. J. HERGENROETHER has retired from his position as supervisor of development activities in the automotive industry, Detroit technical field section, International Nickel Co., Inc. He has been a member of SAE since 1929.

MARTIN J. CASERIO has been named manager of the Milwaukee operations of AC Spark Plug Division of General Motors Corp. Caserio joined AC in 1937 and has held many engineering positions including chief engineer, automotive products. He organized and directed the engineering activities on the skysweep anti-aircraft fire control system built for the army.

Caserio has recently resigned as chairman of the SAE Mid-Michigan Section.

MILTON A. FORESTER has joined the engineering department staff of the Automobile Manufacturers Association. Prior to his new post he was manager, development engineering services, with Utica-Bend Corp. where he was responsible for building prototypes of gas turbine and diesel engines and directed activities of experimental shops, procurement, proving grounds, and mechanical laboratories. With AMA, Forester will work primarily on aspects of vehicle safety problems.

WILLIAM A. COMPTON has recently joined the General Atomic Division of General Dynamics Corp. as a research staff member in San Diego, Calif. Compton was formerly manager of research and development of the Jet Division of Thompson Products, Inc.

Compton, who joined SAE in 1955, is active on the SAE Diesel Engine Test Code Subcommittee.

GROVER C. FARNSWORTH, chief metallurgist and laboratory engineer at the General Motors Truck and Coach Division, General Motors Corp., has retired. He leaves after more than 38 years of service with the corporation.

WILBUR J. SCHEUTZOW has been made staff engineer at the Cleveland Ordnance Plant, test and development section, Cadillac Motor Car Division, General Motors Corp. Formerly he was assistant staff engineeer in the turret and armament section.

JOHN PRIOR has been appointed staff engineer at the Cleveland Ordnance Plant, Cadillac Motor Car Division, General Motors Corp. He is in charge of the power train consisting of engines, transmissions, and final drives.

Prior was formerly assistant staff engineer in charge of test and development in the engineering laboratory.

THOMAS A. BISSELL is now executive secretary of the Society of Plastics Engineers, Inc. For many years Manager of the Meetings Division of SAE's headquarters staff, Bissell took over this top staff post with SPE about the middle of November. Headquarters of SPE, a 5000-member national organization, are at 34 East Putnam Ave., Greenwich, Conn. SPE aims are to promote the arts, sciences, engineering practices, and standards connected with the use of plastics.

DAVID FIRTH, vice-president in charge of engineering, Dodge Mfg. Corp., has recently been elected to the board of directors of J. H. Fenner (Overseas) Ltd. of Hull, England. The Fenner organization controls the sales of four other English companies and one India company which manufacture all types of belting, including automotive V-belts, seals, and engineering

Members



Gruse Woodley Naumann Spencer Swardenski



Eksergian Wilhite Ziskal Archangeli Ramsay



Crosby Watkins Hooven Kope Venditty

products for power transmissions.

Firth has beeen with Dodge since 1940 in his present post, and now spends six weeks annually in Europe serving companies in England and France who manufacture under license of patent granted to him.

WALTER E. THILL has been named chief engineer of the recently established service engineering department, Federal-Mogul Service Division, Federal-Mogul-Bower Bearings, Inc. Thill has been with the company since 1938, and formerly was assistant chief engineer of the Federal-Mogul Division.

Thill serves on the SAE Detroit Section Governing Board and as business manager of the Detroit Supercharger.

RICHARD O. GORDON has joined the Mobile Hydraulics Division of Vickers, Inc. He will supervise all sales activity and guide engineering design relating to Vickers hydraulic power steering boosters.

C. DOUGLAS FLANIGEN has been made chief engineer, Lycoming Division of the Avco Mfg. Corp.

Flanigen was formerly engaged as a consultant engineer on the design and marketing of aircraft and missile components. Prior to September, 1956, he was with the Bendix Aviation Corp. as chief engineer of its Utica Division.

WILLIAM A. GRUSE, administrative fellow of the Gulf Oil Co. Fellowship at Mellon Institute, has retired. He joined the Gulf Fellowship in 1919 and in 1923 became Senior Fellow and started a long series of researches on engine deposits which continued for 33 years.

At present Gruse is a lecturer in the Schools of Engineering and Mines, University of Pittsburgh, and division director, Gulf Research and Development Co. He is also director of educational courses for Gulf's Graduate Work in Industry Program, University of Pittsburgh.

Gruse has served as chairman of SAE Committee E-7 on Vapor Lock and as a member of the SAE Committee on Crankcase Oil Stability.

CHARLES A. WOODLEY has been elected executive vice-president of Caterpillar Tractor Co. Woodley has been with Caterpillar since 1926 and was elected vice-president in October, 1954. In his new capacity he will continue to give administrative direction to the company's manufacturing division.

WILLIAM L. NAUMANN is manager of the Peoria plant of Caterpillar Tractor Co. He has been with the company since 1929 and formerly was manager of the Joliet plant.

THOMAS H. SPENCER is now Peoria plant quality control manager of Caterpillar Tractor Co. He has been with the company since 1936 and was Peoria plant metallurgist prior to his new position.

GORDON SWARDENSKI is now assistant plant manager, Peoria plant, Caterpillar Tractor Co. He has been with the company since 1930 and was formerly manufacturing manager, Peoria plant.

C. L. EKSERGIAN has been made vice-president in charge of engineering, Automotive Division, the Budd Co. Formerly he was executive engineer with the company, having joined Budd in 1923. He holds approximately 200 patents in the automotive and railway passenger car fields.

C. J. WILHITE has been appointed manager, field service, for the Cummins Engine Co., Inc. Wilhite has been affiliated with the company since 1939 and was assistant sales manager prior to his new appointment.

JOSEPH F. ZISKAL has been appointed manager of engineering for International Harvester Co. of Great Britain, Ltd. Ziskal was formerly with the Farm Tractor Division of the company in Chicago.

MARTIN D. ARCHANGELI, assistant general manager of the Saginaw Division, Eaton Mfg. Co., has been made general sales manager for the company, a newly created position. Archangeli has been with Eaton since 1922 and has served as sales manager of the Saginaw Division and general manager of sales for Saginaw, Valve, and Aircraft Products divisions.

R. A. RAMSAY, formerly Detroit district manager of the Bearings Division, Torrington Co., has been appointed sales manager of the Mechanics Universal Joint Division, Borg-Warner Corp.

V. A. CROSBY, manager, Automotive Development Section, Climax Molybdenum Co., talked recently at the Cleveland Chapter of the American Foundrymen's Society on "Engineering Casting with Reference to Automation." Castings, Crosby defined, as "those to which accepted engineering talent has been applied to produce soundness, strength, ease of production, and ease of machining to meet the stress requirements desired." He also emphasized that "automation whether in the foundry or machine shop imposes closer restriction on both uniformity and dimensional tolerance."



SAE PAST-PRESIDENT R. J. S. PIGOTT, consulting engineer of Pittsburgh, Pa., has been awarded the Elliott Cresson Medal of The Franklin Institute, Philadelphia. Pigott has been cited "In consideration of his engineering accomplishments, including his many valuable inventions, his painstaking research, his notable contributions to the technical press, and his engineering leadership." Pigott is retired from Gulf Research and Development Co., after having served as director of engineering from 1929 to 1952.



JOHN JAY IDE, consultant to the chairman, NACA, has received the Paul Tissandier Diploma for 35 years of association with the International Aeronautic Federation. The award presentation took place at the Conference of the FIA in Palermo, Sicily.

W. M. WATKINS, JR., former sales engineer specializing in automotive and aircraft seals, has been named sales manager of the newly-formed Seal Sales Division of the Robertshaw-Fulton Controls Co.

J. L. HOOVEN, executive engineer, Ford advanced car and truck engineering, Ford Motor Co., will direct the newly established advanced truck product engineering office of Ford.

C. T. KOPE has been appointed manager, advanced truck vehicle engineering department, Ford Motor Co. Prior to this appointment, Kope was assistant chief engineer, light and medium trucks, for the company.

C. G. VENDITTY has been appointed manager, advanced truck chassis engineering department, Ford Motor Co. Prior to the new appointment, Venditty was chief advanced truck engineer of Ford's Engineering Staff.

PATRICK JOHN VALANT, formerly product design engineer, Ford Motor Co., is now quality control engineer with the company.

D. RICHARD OLINGER, formerly chief industrial engineer for the J. I. Case Co., is now chief engineer for the Rome Plow Co. in Cedartown, Ga.

WALTER VOGEL is now an industrial engineer on special assignment with Heinrich Lanz A.G. in Mannheim, Germany. Formerly he was an industrial engineer with the John Deere Waterloo Tractor Works in Waterloo, Iowa.

JESS VIRGIL TERRY, formerly sales manager for Rother Auto Parts, is now in sales with the Patterson Parts Co. in Oakland, Calif.



WALTER E. LAY, professor of Mechanical Engineering at the University of Michigan, stands beside a bust of himself presented by his former students at time of the dedication ceremonies of the University's new Automotive Engineering and Aeronautical Engineering Laboratories on October 15. Lay has taught automotive engineering courses at the U. of M. since 1916.

TOM L. BURCHAM has been made a supervising engineer in the research department of Caterpillar Tractor Co. Burcham joined Caterpillar in 1952 and was a proving ground research engineer prior to his new appointment.

EDMOND E. BISSON, assistant chief of the National Advisory Committee for Aeronautics' Lewis Laboratory's Fluid Systems Division, has presented technical papers at the International Conference on Lubrication and Wear in London, England, and at a similar conference in Toronto, Canada.

Co-authors of these papers with Bisson are **R. L. JOHNSON,** aeronautical research scientist, NACA Lewis Laboratory, and **M. A. SWIKERT,** mechanical engineer, NACA Lewis Laboratory.

GORDON H. MILLAR is now engineering manager for the Meriam Instrument Co. in Cleveland. Formerly he was supervisor, advanced powerplant section, Ford Motor Co. In his new post, Millar will investigate the application of linear flow meters for airflow measurement in vehicles.

F. L. HALL, formerly president of the Winona Mfg. Co., is now account executive, manufacturer's sales, Goodyear Tire and Rubber Co.

HARVEY D. FERRIS is now a stress analysist, mechanisms section, Atomic Energy Division, Babcock and Wilcox Co. Formerly he was a designer in the powerplant group of Bell Aircraft Co.

ROBERT WILLIAM MARTIN, formerly project engineer for the New Departure Division of General Motors Corp., has joined the Martin Engineering Co. in Fort Branch, Ind., as production manager.

NICHOLAS P. MILLER has joined B.H.T. Products Corp. as production manager. Formerly he was chief service engineer, American Brakeblok Division, American Brake Shoe Co.

Miller serves as a member of SAE Brake Committee's Bonding of Brake Lining Subcommittee.

BERNARD GOULSTON, formerly manager of service laboratory, research department, has been made coordinator, technical services, marketing department, for Imperial Oil Ltd., Toronto, Ont., Canada.

WILLIAM MORRISON PITCHER, formerly in industrial sales with the Esso Standard Oil Co., has become sales supervisor for the company in Rochester, N. Y.

CHARLES F. GRUBER has been made manager of quality control for Massey-Harris-Ferguson, Ltd., in Toronto, Ont., Canada. Formerly he was chief inspector for the company in Detroit.

SAE Members Say:

M. C. PATTERSON
President, Dodge Division, and vice-president, Chrysler Corp.

Patterson recently addressed the American Society of Body Engineers in Detroit. He spoke on "the Evolution of the 1957 Dodge."

He stated that the divergent interests and objectives of the stylist, performance engineer, safety engineer, body engineer, and sales department produce conflict on the development of a new design. Patterson concluded, "Obviously the job of designing a car that meets all these objectives is impossible. . . . It is only as such conflicting ideas can be brought together into a working compromise that a practical, saleable car of advanced design can possibly be evolved."

ROBERT F. THOMSON
Head of the metallurgical engineering department, Research Staff, General Motors Corp.

Thomson has been honored by the American Society for Metals as author of the 15th Annual William Park Woodside Lecture.

He predicted that outstanding industrial developments in the next half century will result from the fact that metallurgical science is now equipped with more understanding, materials, and support in solving problems than ever before.

Thomson cited increased research hours spent defining physical phenomena, availability of new energy sources to replace those which might run out, and technological progress.

CHARLES A. CHAYNE
Vice-president in charge of the Engineering Staff, General Motors Corp.

Chayne addressed the 18th annual General Motors safety conference of plant safety engineers.

"Safety designs and devices not withstanding, traffic safety is a direct function of the driver's basic sense of responsibility, his attitude, his self discipline . . ." declared Chayne. He showed that the last nine years of test driving on GM proving grounds statistically eliminated both vehicle and road as causes of accidents, leaving only the driver.

ARTHUR E. RAYMOND, vice-president-engineering of Douglas Aircraft Co., has been selected to receive the 1957 Daniel Guggenheim Medal "for notable achievements in the advancement of aeronautics." Formal presentation of the medal will be made Jan. 28, 1958.

Raymond was elected Honorary Fellow of the Institute of Aeronautical Sciences for 1949 and was awarded the U. S. Certificate of Merit for his contributions to aircraft production during World War II.

He was an SAE Councilor in 1946–47.

M. Le ROY STONER, secretary, SAE Technical Board, participated in the European Productivity Agency Symposium in Washington, D.C., on October 29. He presented a talk on SAE's scope of operations, particularly in the technical field. The purpose of the panel discussion was to familiarize the personnel from Western European countries with the aim and function of important United States technical societies active in specifications and testing.

F. DANIEL APPLEGATE has been named project engineer on the F 102, Convair Division, General Dynamics Corp. Prior to his new post, Applegate was the senior design group engineer working on propulsion and air conditioning, Convair.

RALPH F. PEO, president and chairman of the board of Houdaille Industries, Inc., has been cited by the University of Buffalo as a "pioneer in industrial development."

Peo is recognized as an inventor with more than 150 patents, and has long been active in furthering the industrial and educational expansion of the Buffalo area.

ALFRED HASELDEN, formerly project engineer for the Ford Motor Co., is now with Massey-Harris-Ferguson, Ltd., London, as director of manufacturing for the Eastern hemisphere.

WILLIAM F. BLAND, formerly editor of "Petroleum Processing" is now assistant to the publisher with McGraw-Hill Petroleum Publications, McGraw-Hill Publishing Co.

TED C. DU MOND, former editor-in-chief of "Materials and Methods" has joined the Cleveland headquarters' staff of the American Society for Metals. He will be editor-in-chief of the ASM Metals Engineering Institute's educational courses, which offer specialized correspondence courses and in-plant instruction.

Du Mond, who will also be Secretary of the ASM Special Engineering Program Committee, is a mechanical engineer by training and the author of several books on engineering materials.

Continued on page 103

SAE Father and Sons



Three members of the Fink family —all of whom are SAE members—sign SAE San Diego Section's register. **JAMES E. FINK** (left) is an aerodynamics engineer at Convair and has been an SAE member for two years. **JOHN D. FINK** (middle) is also employed by Convair and has just become an SAE member. Their father **FRANK W. FINK**, vice-president and chief engineer of Ryan Aeronautical, is a longtime SAE member and serves as adviser on missiles to the SAE president.

Obituaries

EDGAR L. FIX . . . (A'56) . . . manager, steel sales, A. M. Byers Co. . . . joined the company in 1933, made assistant manager in 1953, and manager in 1955 . . . died Sept. 27 . . . born 1906 . . .

HAROLD H. GASSER . . . (A'55) . . . general sales manager, Kelsey-Hayes Co. . . . had been with the company for 28 years, named to sales manager in 1955 . . . died recently . . . born 1902 . . .

AUBREY L. WHITTEMORE . . . (A'43) . . . president, A. L. Whittemore Co., New Zealand . . . died July 28 . . . born 1888 . . .

STANLEY WHITWORTH . . . (M'12) . . . retired consultant, automotive . . . designer of the Stutz Bearcat . . . entered automotive industry in 1904, became vice-president of Bendix Brake Corp. in 1926, and vice-president of Studebaker Corp. in 1933 . . . retired in 1947 . . . died Oct 15 . . . born in England in 1881 . . .

SAE CEP COOPERATIVE ENGINEERING PROGRAM NEWS



M. G. Beard, (r.), chairman of SAE Aircraft Cockpit Standardization Committee, receives declassified data from Admiral Rawson Bennett.

Declassified Cockpit Data Released To Industry Through SAE

DATA on a new, highly integrated, flight-tested, cockpit instrument panel of the future were declassified at an October 14 Army-Navy Instrumentation Symposium. The declassified material was presented by Admiral Rawson Bennett to M. G. Beard, chairman of SAE's Aircraft Cockpit Standardization Committee, which has been following the project in its classified state for over a year. Tested in high-performance Navy jets last summer, the new instrument panel provides a 2-dimensional television-type presentation of the outside world for the pilot under all weather conditions.

Since its inception four and a half years ago, the project has been under the guidance of Com. G. W. Hoover. It was publicly demonstrated for the first time on October 14 to mark the opening of the symposium, which was attended by more than 1000 members of industry and the services.

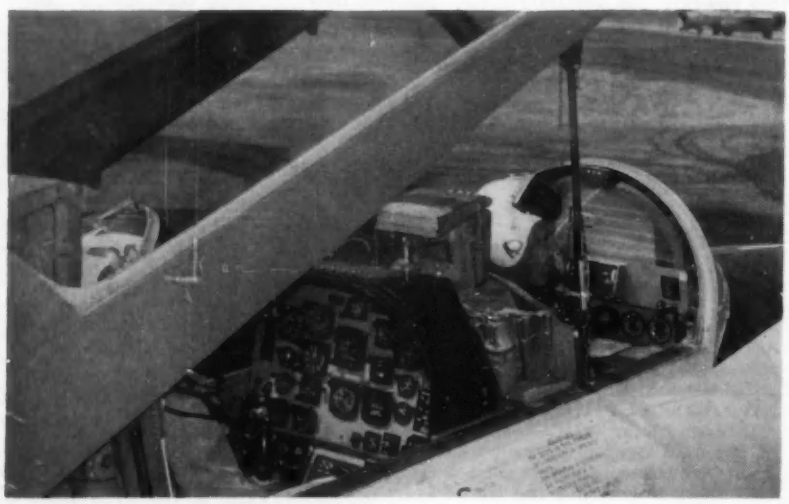
Basically, "ANIP," or the Army-Navy Instrumentation Program as it has been designated, consists of a 2-dimensional picture, presented on a flat, transparent, television tube 2 5/6 in. thick, 20 in. wide, and 11 in. high. It is fed information from a small, lightweight, electronic computer. The resultant picture is artificially generated and gives the perspective of the third dimension, thus giving the pilot terrain and sky information to assist his control of the aircraft.

The screen, called a contact analog, sits in the front of the cockpit, much like a second windshield, and when not in use, it can be seen through by the pilot as if it were a window. The analog's picture is on a direct one-to-one ratio to what the pilot can see through his windshield on contact flight conditions.

A digital computer serves as a bantam "answer box" which, through its electronic computations, not only shows the pilot his plane's true air speed, Mach number, altitude, and rate-of-climb, but also makes cruise control computations and comes up with performance predictions for any given set of circumstances.

Admiral Bennett said that the ANIP system is expected to become operational in Navy aircraft in two to three years, but added that new research and development are continuing in an effort to provide a more advanced system to simplify a pilot's complex functions even further.

Upon accepting the declassified material, Mr. Beard stated that "The Army and Navy have done a great service to the air transport industry in declassifying and releasing this material." He also said that testing of the ANIP system had "lifted the project from the stage of theory into the realm of practicality."



Simplicity is key to new instrument panel contrasted at right with standard instrumentation at left. The new panel was developed under prime contract to Douglas Aircraft Co.

Sound Deadener, Sealer, Adhesive Group Created

THE first meeting of the Sealers, Adhesives, and Deadeners Subcommittee was held October 24 in Detroit with D. L. Jones, Ford Motor Co., presiding as chairman.

Created by the Nonmetallic Materials Committee at the suggestion of the Body Engineering Committee, the new group will concentrate on test methods and specifications for automotive body applications.

As a result of the October meeting, four proposed reports are being prepared which apply to putty-type sealers, plasticol and drip rail sealers, spot-weld sealers, and general-purpose trim adhesives. The subcommittee is also reviewing an existing SAE recommended practice, Sound Deadeners and Underbody Coatings, which appears in the 1957 Handbook.

The subcommittee's next meeting is scheduled for the latter part of January.

Status of High-Temp Hydraulic Pumps Revealed

THE current status of high-temperature hydraulic pumps for aircraft was reviewed by members of Subcommittee A-6C, Hydraulic Pumps, Motors, and Air Compressors, at their October meeting. Upon hearing the following, the subcommittee generally concluded that pump research and development appears to be abreast of future airframe requirements.

In the design stage at New York Air Brake is a 10-gmp, 700 F, 4000-psi, 4500-rpm pump which calls for Versilube F-50. Delivery capacity has been increased 12% over required delivery to overcome a marked decrease in bulk modulus in fluids being pumped at higher temperatures.

New York Air Brake is also working on a 35,000-rpm, 10-gpm pump. The pump, which represents a considerable departure from standard design, is to operate at 500 F oil-inlet temperature with Monsanto OS45-1 at 3000 psi.

A 550 F pump is under development at Vickers, Inc. 450 F units (in certain sizes) are now available. Tests have been run up to 650 F, and it has been observed that ambient temperatures seem to have very little effect on overall pump operation as long as pumps are not stroked to very low flows.

Denison Engineering tests have been primarily confined to 300–350 F oil-inlet temperatures. In two cases, tests have been run to 400 F. Up to 300 F, Denison has used MIL-O-5606, and for higher temperatures, OS45-1.

A small, high-speed pump (7500 rpm) of approximately 0.2 cu in. displacement has been operated by General Electric Co. at 525 F oil-inlet temperature for 100 hr.

Bendix Aviation has operated a 2-gpm, 1500-rpm, 5000-rpm pump at 550 F oil-inlet temperature for 50 hr.

The majority of Hamilton Standard testing has been in the 350–450 F range with pumps of the 2′, 3′, and 10-gpm size and up to 8000 rpm. Pumps have been operated with OS45-1, MIL-L-7808, and Versilube F-50.

Actual Hydraulic Pump Service Conditions Sought

AS a result of the need for improved correlation between laboratory testing of hydraulic pumps for aircraft and actual service conditions, a panel has been created by Subcommittee A-6C, Hydraulic Pumps, Motors, and Air Compressors. The panel will study factors which can be incorporated into existing laboratory tests.

Under the chairmanship of E. V. Manning, New York Air Brake Co., the panel will formulate recommendations to the military for a research and test program to determine the relative importance of the various parameters (such as vibration, fluid breakdown, and contamination) now called for in laboratory qualification tests.

Panel Members

Other panel members include: K. I. Postel, Vickers, Inc.; C. C. Smith, Lockheed Aircraft Co.; R. E. Kibele, North American Aviation; E. L. Shaw, Denison Engineering Co.; and J. R. Snyder, McDonnell Aircraft.

Leaded Steel Gains Society Recognition

INCREASED use of leaded carbon steels is indicated by Technical Board approval of a new "leaded steel," which has been designated 12L14. The steel is the first of its kind to be graded by the Society. It is expected that as other leaded carbon steels are produced in greater volume, they too will receive recognition.

Leaded to improve machinability, 12L14 will be listed in a table on free-cutting steel compositions directly beneath 1113 in the next edition of the SAE Handbook. It will appear as follows:

SAE Number	C	Mn	P	S	AISI Number
12L14[d]	0.15 max	0.80–1.20	0.04–0.09	0.28–0.35	———

[d] Lead 0.15–0.35

Recognition of 12L14 will also modify three of the tables which appear in the SAE Standard, Permissible Variations from Specified Chemical Ranges and Limits for Steels.

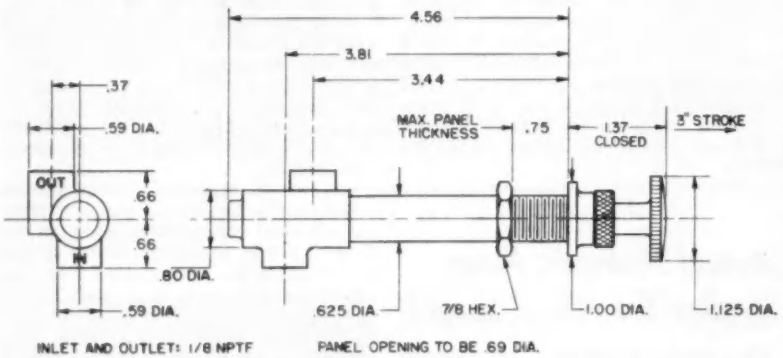
Originally proposed by the American Iron and Steel Institute in 1955 after consideration by AISI's General Technical Committee, the steel has been under study in SAE Iron and Steel Technical Committee's Division 7, Carbon Steel, for the last year and a half. In 1956, the Technical Board approved AISI's designation and the use of the letter "L" to indicate leaded carbon steels in all future standards. 12L14 was finally approved by the Technical Board in October 1957.

Filter Test Methods Group Inspects Test Facilities



Several members of the Filter Test Methods Subcommittee of SAE's Engine Committee are shown taking time out from their October meeting to inspect test equipment at the U. S. Naval Engineering Experiment Station in Annapolis, Md. Currently, the subcommittee is preparing procedures and methods for rating fuel injection system filters.

Fuel Pump-Engine Primer Mountings Proposed



A PROPOSED SAE recommended practice on panel mountings for diesel fuel pumps or engine primers is being circulated for comment to industry via *SAE Journal* readers by the Fuel Injection Mounting Subcommittee of the Engine Committee. The purpose of the report is to insure that connecting tubes will not require rebending when new primers are installed.

Dimensions shown above represent the maximum envelope of present primers. However, fitting locations (outlet and inlet) are identified with a substantial portion of current practice. Unless otherwise specified, dimensional tolerances on drawings are: For two decimal dimensions: ±.010; for three decimal dimensions; ±.005.

Comments on the proposed report would be welcomed from *SAE Journal* readers and should be forwarded to Subcommittee Chairman R. L. Shallenberg, who is chief engineer for fuel injection systems at International Harvester Co., Construction Equipment Division, Melrose Park Works, Melrose Park, Ill.

SAE Furthers Aims of International Drafting Practice Conference

SAE members and technical committeemen contributed heavily to the aims of the American-British-Canadian Conference on the Unification of Drafting Practices held October 7–11 in Toronto, Canada. With an objective similar to the cooperative work done after World War II on screw threads, the ABC Conference was held to identify further areas of potential agreement on drafting practices in the three English-speaking countries.

Five members of SAE's Joint Aeronautical-Automotive Drawing Standards Committee attended the meeting. **P. G. Belitsos**, chairman of the Joint Committee, presented a paper entitled "The American Approach to the Specification of Maximum Material Conditions on Drawings." **R. P. Trowbridge**, who is also an Automotive Drafting Standards Committee member, and Co-Author Leon DeMause presented a paper on "Areas of Agreement and Disagreement of the United States, Great Britain, and Canada." **Joseph Stannard**, in cooperation with N. Brown, prepared a paper on "The American Approach to True Position Dimensioning." **F. H. Smith** and **D. J. Gerardi** attended the conference as accredited observers. Gerardi and Stannard are also members of Committee S-1, Aeronautical Drafting Manual.

Prof. C. H. Springer, a consultant member of S-1, served as a member of the United States Delegation along with Belitsos, Stannard, and Trowbridge.

J. G. Morrow, an SAE member since 1935, participated as the Canadian member of the ABC Executive Committee.

At the conference, many significant agreements were reached, particularly in the field of dimensioning and tolerancing. When implemented, they will make it possible for drawings exchanged between the English speaking countries to be easily understood. Conference recommendations will be the basis for future discussions to take place within the drafting standards committees of the U. S., Britain, and Canada.

The last major ABC agreement was reached in 1948, and resulted in a unified screw thread system based on the inch. The British, at that time, abandoned their historic Whitworth (55-deg) thread in favor of the American 60-deg thread.

Truck Ability Prediction Procedure Revised

Truck Ability Prediction Procedure, an SAE recommended practice, has been revised to include current data on air resistance, tire factors, and acceleration prediction procedures. The latter will be particularly helpful to operators in predicting stop and start performance, and also will aid in the design of access roads to highways.

Prepared by the Transportation and Maintenance Technical Committee, the report's content will form the basis of a paper to be presented at SAE's January Annual Meeting in Detroit. Although it will not appear in the SAE Handbook, the document is available from SAE Special Publication Department as TR 82. Price: $2.50 to members; $5.00 to nonmembers.

A. E. Gibson Dies, Was Active in Committee Work

A. E. GIBSON died on October 13. An active participant in SAE technical and activity committee work, Gibson served as a member of Committee E-21, General Standards for Aircraft Engines; Committee E-25, Engine and Propeller Standard Utility Parts; and Committee S-1, Aeronautical Drafting Manual. He was also a member of SAE's Aircraft Powerplant Activity Membership Committee.

Born in Boston in 1906, Gibson was educated at the Lowell Institute of Technology in Cambridge, Mass. His career began as a designer at General Electric's River Works Plant in Lynn, Mass. Subsequently, he became chief design checker, Allison Division, GMC; assistant to the president, Turbo Engineering Corp.; chief draftsman, Aircraft Engine Division, Packard Motor Car Co.; and administrative engineer at Fredric Flader, Inc., Willys Motors, Inc., and Lycoming up to the time of his death.

Fellow committee members will miss Mr. Gibson's friendship and excellent council at their meetings.

'55 Road Rating Data Analyzed by CRC Panel

MODIFIED Uniontown and Borderline road octane numbers of five CRC full-boiling reference fuels and three experimental high-octane-number fuels were established as a result of the 1955 program of the Road Rating Exchange Panel of the CFR-MFD Road Test Group. These ratings, which are presented in CRC Report No. 311, were developed by 18 participating labora-

tories using 44 test vehicles of 19 different makes or models or modifications thereof. Of these 19 vehicle types, six were represented by three or more of each make. Based on these replicate determinations, average road ratings of the test gasolines in these cars were computed.

It was found that six different car makes rated the fuels similarly. One car rated the high-octane-number fuels higher than the other cars by the Modified Uniontown and low-speed Modified Borderline methods.

Overall Ratings Summarized

A summary bar-chart of the overall vehicle ratings is presented which includes ranges, averages, and depreciation values (Research minus all vehicle average) of the 44 test vehicle ratings. Among the results are the following:

- The range of vehicle ratings varied with fuels and test methods, but these ranges did not change consistently relative to such variables as fuel octane number, test technique, or engine speed. The magnitude of the ranges averaged about seven octane numbers.

- The average ratings of the fuels were generally about the same for Modified Uniontown and 1500-rpm Modified Borderline Techniques.

- The Modified Borderline ratings at 3000 rpm were lower, especially at high octane-number levels, than the Modified Uniontown or 1500-rpm Modified Borderline ratings.

CRC Report 311, "Analysis of the 1955 Road Rating Exchange Data," contains 93 pages including tables, figures, and appendixes.

To Order CRC Report No. 311 . . . on which this article is based, see p. 5

New Recommended Practice on Measure Of Vehicle Radio Interference Approved

A NEW recommended practice, Measurement of Vehicle Radio Interference, has been approved by the Technical Board. It will, for the first time, give design engineers an accurate and reproducible method of measuring the random ignition system radiation from vehicles.

The break-through came with the development of a measuring system that incorporated the following:

- A basic unit of measurement of decibels above one microvolt meter/kilocycle of band width.

- Field intensity readings that are referred to a stable noise generator—thereby eliminating drift in the detection circuit.

- Standardized ground rules for the physical characteristics of the test site.

The scope of measurements in the test procedure is set in the 30 to 400 megacycle range. It is expected that this will cover all normal interference affecting television receivers. The tests of radiation call for peak values of the radiated signal.

Solutions to the problem of accurate and reproducible measurement have been sought by the Vehicle Radio Interference Subcommittee of SAE's Electrical Equipment Committee since before World War II.

The members of the present subcommittee are: Chairman B. H. Short, A. D. Baker, N. G. Bauer, W. K. Carson, M. H. Elkin, R. O. Ellerby, O. C. Fay, S. A. Findley, L. J. Heine, W. K. Jensen, M. P. Klintworth, E. A. Leavengood, E. J. Lourie, K. F. Maier, W. L. Marett, P. W. Maurer, R. G. Morris, C. J. Parker, C. W. Rainey, G. E. Spaulding, R. C. Stinson, E. J. Szabo, C. W. Thomas, and R. S. Thornburgh.

CRC Evaluates Gas Turbine Fuel Deposits

A TEST machine, known as the CFR fuel coker, has been developed to evaluate tendencies of aviation gas turbine fuels to deposit decomposition products in the fuel system components of high-performance engines. On the basis of data obtained from a cooperative test program, suitable test techniques have been established for evaluating different fuels. They are presented in CRC Report 310 along with a description of CFR fuel coker operation and maintenance.

The Fuel Thermal Stability Group of CRC's Coordinating Fuel and Equipment Research Committee reached the following conclusions in connection with their 1955–56 investigation.

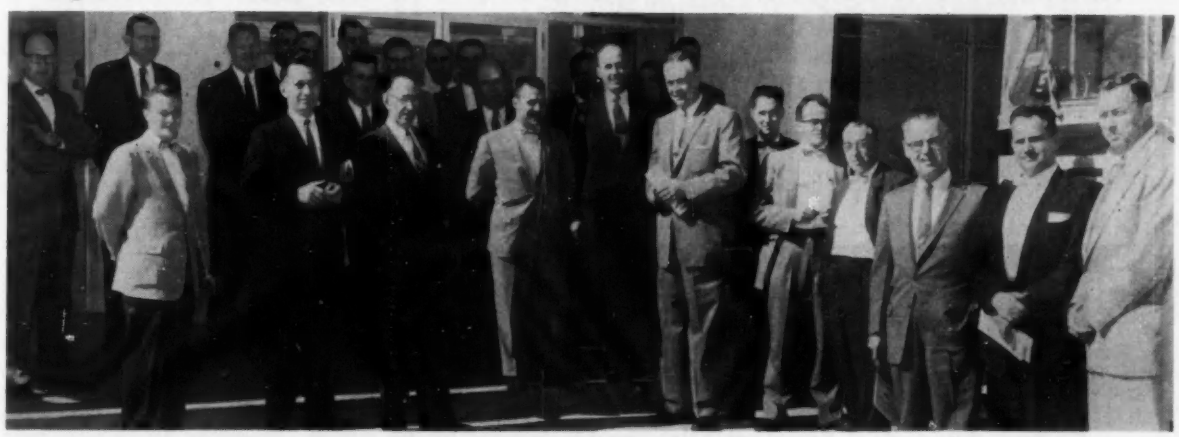
- The CFR fuel coker is capable of distinguishing between fuels of different thermal stability. The certainty with which fuels can be separated depends on the degree of difference and the number of tests run.

- CFR fuel cokers have been operated at preheater temperatures up to 450 F and filter temperatures up to 500 F.

- By making a series of tests on one fuel at different temperatures, it is possible to determine for exploratory purposes the threshold temperature of fuel

Continued on next page

Ignition Research Committee Tours TWA's New $25-Million Overhaul Base



The Ignition Research Committee toured the new $25-million Trans World Airline Overhaul Base at Midcontinent International Airport, Parkville, Mo., after their October meeting in Kansas City. Special attention was paid to the ignition system test equipment located in the Powerplant Overhaul Building. The group also visited airframe overhaul and engine test facilities. Shown above with IRC members are Chairman C. M. Dean (third from right) and TWA Host C. A. Fisher (extreme right).

700 PARK CLOSED-DIE FORGINGS

. . . Wt. 2750 Lbs. Ea.

SAVE MACHINING TIME
Eliminate
"POROSITY REJECTS"



for manufacturer of automotive glass-making machinery

A Park sales engineer showed this manufacturer of an automated glass-making line how to save money by using large, closed-die forgings. These Park closed-die forgings were closer to being completed parts—needed a minimum of final machining. Uniform in quality, they required less inspection. And there was no danger of investing expensive machine time in parts—then have them rejected because they contained "blow-holes" or porosity defects.

One of the largest production runs of closed-die forgings ever scheduled for the machine tool or machinery field, these 700 forgings, each weighing 2750 lbs., were produced in Park's shops in record time.

Let our sales engineers show you how a Park closed-die forging can cut down machine time and rejects—increase strength and safety on your product requirements.

Die Forging Specialists Since 1907

THE PARK DROP FORGE CO.
775 EAST 79TH ST. • CLEVELAND 3, OHIO

Carbon, Alloy, Heat-Resistant Alloy, and Stainless Steel Closed-Die Forgings from 5 lbs. to 5000 lbs.

CEP News

Continued from page 95

stability. This is the temperature established in the CFR fuel coker at which fuels start either to form visible preheater deposits or to plug the filter.

• Some fuels are inherently easy to evaluate since they exhibit a sharp "break point" in temperature where they start to form deposits. Other fuels may not exhibit a sharp "break point"; hence, they are more difficult to evaluate. The results by the threshold temperature technique indicate a standard deviation of ± 31 F on the average for the fuels tested. The average reproducibility of threshold temperature is ± 51 F for 90% certainty range of about 100 F, or one-fourth of the total range of the instrument.

• By testing a fuel at a given, fixed set of conditions with the CFR fuel coker, it is possible to determine whether or not the fuel in question is thermally stable at the chosen conditions by means of a "pass-fail" type of test.

• The CFR fuel coker can evaluate fuels of various volatilities. The present configuration is designed to permit preheater temperatures to approximately 350 F for JP-4 type fuels and to approximately 450 F for JP-5 type fuels.

• Data supplied by engine manufacturers indicate a relationship between CFR fuel coker results and deposit and varnish formations in full-scale equipment. The best fuels are clearly distinguished from the poorest fuels while fuels of intermediate quality are not necessarily rated in precisely the same order in full-scale equipment.

CRC Report 310, "Investigation of Thermal Stability of Aviation Turbine Fuels with CFR Fuel Coker," contains 61 pages including CRC Manual No. 3 on CFR Fuel Coker Operation and Maintenance, tables, figures, and appendixes.

To Order CRC Report No. 310 . . . on which this article is based, see p. 5

CRC Releases Eight New Reports

THE following Coordinating Research Council reports have been released for distribution and are available from SAE Special Publications Department. (This is a complete list of CRC re-

Continued on page 99

MORE THAN



10,000,000

HYATT TAPERED ROLLER BEARINGS

WERE BUILT INTO 1957 MODEL AUTOMOBILES!

Nearly half of all American cars and trucks built today have HYATT Tapered Roller Bearings

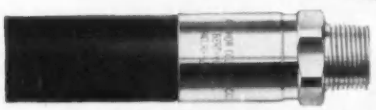
That's right—over *ten million tapered* roller bearings were supplied by HYATT during the 1957 model year. Pretty convincing proof that America's recognized leader in the cylindrical bearing field is also a big and growing source for *tapered* roller bearings!

No facilities in the industry surpass HYATT'S multi-million dollar, fully integrated production lines which are turning out tapered roller bearings with greater uniformity than ever before achieved in quantity production. You'll find *things run smoother* when they roll on HYATT bearings! Hyatt Bearings Division, General Motors Corporation, Harrison, N. J.; Detroit; Pittsburgh; Chicago; and Oakland, California.

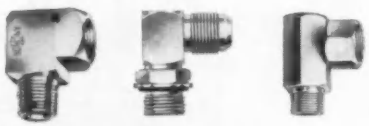
1908–1958
GM
FORWARD FROM FIFTY

HYATT HY-ROLL BEARINGS

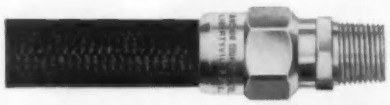
FOR CARS AND TRUCKS



Anchor High, Medium and Low Pressure Hose Assemblies for Three, Two and One Wire Braid Hose, Two Rayon Braid Hose and Spiral Wire Suction Hose.



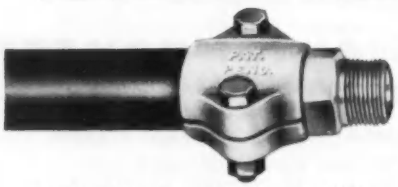
Anchor Adapter Unions, Pipe Fittings and SAE Boss Type Adapters.



Anchor Reusable Couplings for High, Medium and Low Pressure Hose.



Anchor Flanco 4-Bolt, Split-Flange "O"—Ring Couplings with Pressed On Couplings or Clamp Type Reusable Coupling.



Anchor Clamp Type Couplings for high, medium and low pressure.



Anchor L.P.G. Hose Assemblies with Pressed On or Reusable Couplings.



Anchor Automotive Hose Assemblies; Freon Hose Assemblies and Power Steering Hose Assemblies.

There is more than a decade of Research and Development behind these

HYDRAULIC HOSE ASSEMBLIES and FITTINGS!

Here is a complete line, one of the most comprehensive available anywhere today, including couplings, hose assemblies and fittings for any need in the transmission of fluid power.

The Anchor products shown have been developed and re-designed thru the past decade to keep abreast of the rapidly changing field of hydraulics, each style and size offering the most modern features with bonus value in application convenience and service life.

Catalogs are available for each product classification, each with a wealth of diagrams, tables and technical data that are available for your assistance in selecting just the hose assembly or coupling that is best for your particular application.

Andy Anchor says:

A general condensed catalog of the entire Anchor Line is also available. Ask for Catalog 57S.





ANCHOR COUPLING CO. INC.

399 North Fourth Street, Libertyville, Illinois
Branch Offices: Dallas, Tex., Plymouth, Mich.

CEP News

Continued from page 96

ports released since publication of the listing of CRC reports on page 88 of the April, 1957, SAE Journal.)

Aviation Fuels

Thermal Stability

CRC 310—Investigation of Thermal Stability of Aviation Turbine Fuels With CFR Fuel Coker (7/57). Priced at $2.00 to members; $4.00 to nonmembers.

Storage Stability

CRC 312—Report on Aviation Gasoline Desert Storage Program (3/57). Priced at $1.50 to members; $3.00 to nonmembers.

Lubricants

Engine

CRC 306—Development of Research Technique for Study of the Oxidation Characteristics of Crankcase Oils in the CLR Oil Test Engine (3/57). Priced at $3.00 to members; $6.00 to nonmembers. (Limited number available.)

Gear Oils

CRC 308—Development of Test Technique for Determining Load-Carrying, Wear, and Extreme-Pressure Characteristics of Gear Lubricants in Axles under Conditions of High-Speed Low-Torque Operation, Followed by Low-Speed High-Torque Operation (2/57). Priced at $1.00 to members; $2.00 to nonmembers.

Vehicle

CRC 307—Development and Field Testing of Global Greases, 1948–1954 (2/57). Priced at $2.00 to members; $4.00 to nonmembers.

Motor Fuels

Detonation—Full Scale

CRC 309—Octane Number Requirement Survey, 1956 (1/57). Priced at $2.00 to members; $4.00 to nonmembers.

CRC 311—Analysis of the 1955 Road Rating Exchange Data (11/57). Priced at $2.00 to members; $4.00 to nonmembers.

Storage Stability

CRC 313—Phases I, II, and III—Stationary Engine Tests Run by Southwest Research Institute, Gasoline Storage Stability Auxiliary Engine Program (6/57). Priced at $1.00 to members; $2.00 to nonmembers.

6000 cps

—a new high in frequency from a high force vibration exciter system



With new 6000 cps rating, the MB Model C10VB electrodynamic exciter further extends the complex motion testing range . . . yet delivers 1750 pounds force for sinusoidal testing with an MB Model T666 15 KVA amplifier (36,000 watt plate dissipation).

This is versatile equipment. With an MB T666 amplifier and TEMC control cabinet, it has the "muscle" to subject electronic products and other critical components to accelerations up to 58 "g". Adding an MB T88 Complex Motion Console equips it for duplicating the actual "noise" or random motion of the environment. This system is designed with an eye to future needs.

What's more, the exciter works in environmental test chambers, so that vibration can be combined with heat, cold, altitude. This not only saves test time, but gives more realistic data on performance as well.

MB C10VB Exciters have UNIMODE rocker suspension (pat. pend.) which assures linear motion and a uniform spring rate over the total stroke of 1-inch (double amplitude).

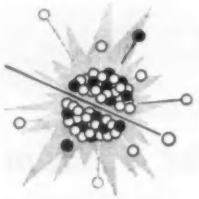
Users of MB test equipment have at their call a nationwide field service organization of vibration specialists to help on application problems. Send for full data on the complete line MB Shakers.

MB manufacturing company

A DIVISION OF TEXTRON INC.

1067 State Street, New Haven 11, Connecticut

HEADQUARTERS FOR PRODUCTS TO ISOLATE . . . EXCITE . . . AND MEASURE VIBRATION



NUCLEAR NEWS NOTES

Nuclear Developments Stimulate Other Fields

Reported by **Dr. L. R. Hafstad,** member, SAE Nuclear Energy Advisory Committee

THE need to design for high temperatures and other unusual conditions encountered in reactors and related nuclear equipment is having a tremendous impact on engineering research in many fields. Products and processes developed in other industries must be studied and improved upon for use in nuclear equipment—and the results of this research then benefit both the nuclear and the original fields.

Metallurgists, in particular, are being called upon to produce—for use in reactors—metals with a combination of properties never before needed. Radiation stability, special nuclear properties, and corrosion resistance must be combined with good high-temperature performance if a metal is to be useful in many parts of a nuclear reactor.

One indication of the growing importance of developing new metals to meet these requirements is the recent creation of a new firm, Mallory-Sharon Metals Corp., which will concentrate on hafnium and zirconium.

As a specific example of where this stimulus of other fields is likely to take place, we might consider the development of the gas-cooled, closed-cycle reactor-turbine system being planned by the Maritime Administration and the AEC for propulsion of a merchant ship. Specifically, might be mentioned:

1. The need for finding a working fluid that does not become radioactive on traversing the reactor, while still having good thermodynamic properties. Various gases are being studied, with helium, nitrogen, and carbon dioxide being the most likely candidates.

2. The need for developing lightweight heat exchangers with high reliability. Regeneration will be used extensively, utilizing experience gained in automotive gas turbine designs.

3. The need for materials to stand the high temperatures of the reactor. In this case the reactor outlet temperature is to be around 1400 F, with fuel element temperatures substantially higher.

4. Shaft and flange seals must be developed that can retain the working fluid at operating temperatures.

5. Improved non-oil-lubricated bearings able to stand the high temperatures are needed. Gas-supported and lubricated bearings are very real possibilities.

6. A new control system must be developed, for this will be the first time that the reactor and turbine will be integrated in a closed cycle system.

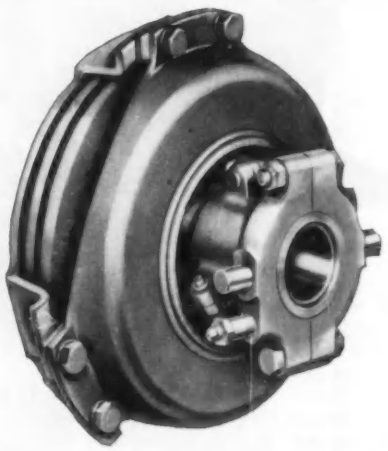
* * *

Engineers engaged in automotive research problems of a chemical nature may be interested in a forthcoming symposium on "Molecular Physics in Chemical Engineering," sponsored by the American Chemical Society. The meeting will be on Jan. 2 and 3, 1958 at the Case Institute of Technology, Cleveland, Ohio. Papers will be presented on: statistical thermodynamics, molecular structure, and kinetic theory.

Further details of the program may be obtained from Prof. R. B. Bird, University of Wisconsin.

ROCKFORD

Single, Double or Triple Plate CLUTCHES



Small Spring Loaded

Heavy Duty Spring Loaded

Oil or Dry Multiple Disc

Heavy Duty Over Center

Power Take-Offs

Speed Reducers

Control POWER Better

The Over-Center, Spring-Loaded clutch shown above—when used in farm tractor LIVE POWER TAKE-OFFS—enables the harvesting unit to be controlled independently of tractor propulsion. It is used in various other ways and in other industries. And it is but one of many types and sizes of ROCKFORD friction CLUTCHES that have been designed and built to meet specific needs. If you have a special power control or power transmission problem, ROCKFORD clutch engineers will be glad to help you solve it.

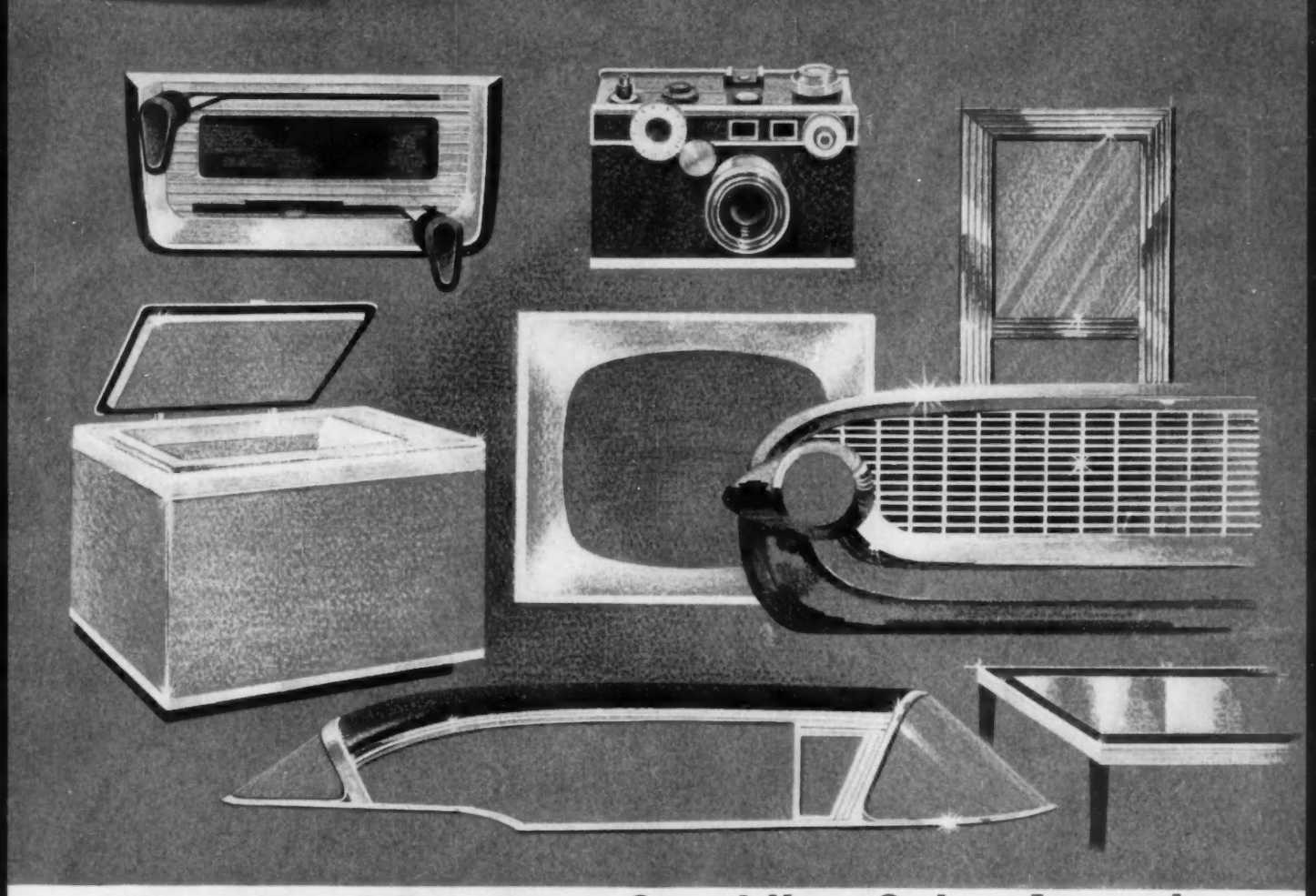
SEND FOR THIS HANDY BULLETIN
Gives dimensions, capacity tables and complete specifications. Suggests typical applications.

ROCKFORD Clutch Division BORG-WARNER

316 Catherine St., Rockford, Ill., U.S.A.

Export Sales Borg-Warner International — 36 So. Wabash, Chicago 3, Ill.

CLUTCHES



Functional Beauty...Sparkling Sales Appeal with Low-cost EXTRUDED ALUMINUM TRIM

Improved design can make the BIG DIFFERENCE in your product sales appeal. Let Bohn Salesmen show you the many advantages of lightweight, low-cost aluminum trim.

Bohn's expanded facilities now offer to all industry:

- Extruded aluminum trim in a wide range of sizes and shapes.
- Complete facilities for plain and color anodizing, decorative painting, silk screening, buffing, etching, chemical brightening, fabricating!
- Complete production and quality control from billet to finished product!
- Design assistance by Engineers and Metallurgists with years of fabricating and anodizing experience!

BOHN

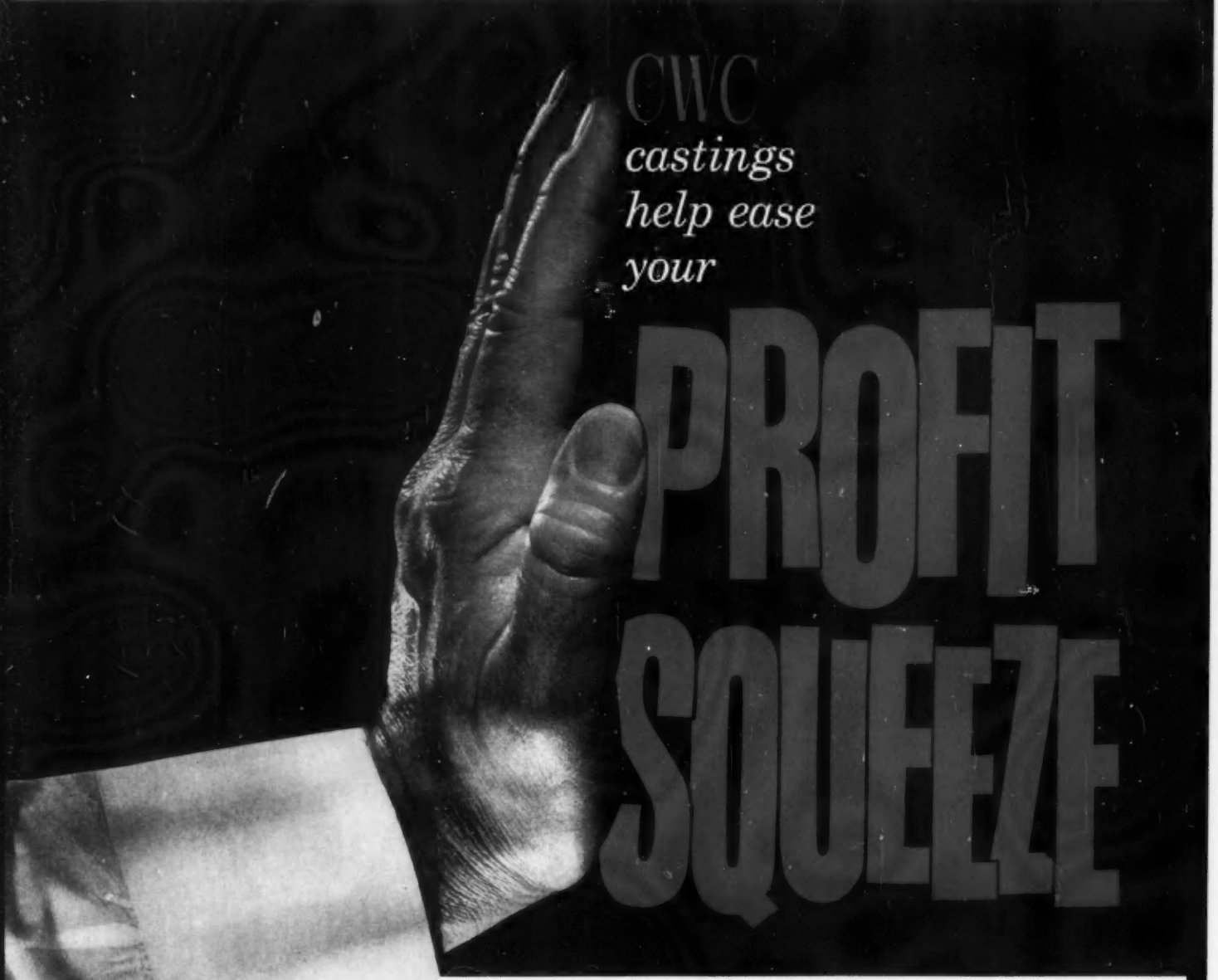
HIGHER EDUCATION
KEEP IT BRIGHT

WRITE OR CALL YOUR NEAREST BOHN OFFICE

SALES OFFICES: *Atlanta • Boston • Chicago • Cleveland • Dayton • Detroit Indianapolis • Milwaukee • Minneapolis • Moline • New York • Philadelphia • St. Louis*

Aluminum and Brass Corporation
Detroit 26, Michigan

REFRIGERATION AND AIR CONDITIONING PRODUCTS • EXTRUSIONS • CASTINGS • FORGINGS • PISTONS • BEARINGS • BRASS ROD • BRASS AND BRONZE INGOTS



campbell,
wyant and
cannon

FOUNDRY COMPANY

DIVISION OF TEXTRON INC.

Muskegon, Michigan

CWC

Let overall savings gained through the use of Campbell, Wyant and Cannon castings help you release the pressure of the profit squeeze! CWC's modern facilities and advanced engineering techniques produce grey iron, alloy iron and steel castings of uniform high quality—castings that machine easier, wear longer, add to product dependability, without premium cost!

Spectrographic analysis, radiographing by million volt X-ray, pre-production planning and tests—all a part of your assembly team. Rely on CWC's creative metallurgical engineering . . . quality control of metals . . . and mechanized production facilities to help you hold production costs down, make your product even more saleable!

Write for the "One Source" story today . . . it's the informative booklet that shows why CWC should be the one source for all your casting needs.

SIX FOUNDRIES LOCATED IN MUSKEGON, LANSING AND SOUTH HAVEN, MICHIGAN . . . READY TO SERVE YOU!

About SAE Members

Continued from page 91

CHESTER D. CHRISTIE, formerly assistant chief engineer of the Axle Division, Eaton Mfg. Co., has been made sales manager of the division. Christie joined the Axle Division in 1939 and was named assistant chief engineer in 1956.

ROBERT K. NELSON, formerly sales representative in the Detroit office of Eaton Mfg. Co., is now assistant chief engineer of the Axle Division in Cleveland. He joined Eaton's engineering department in April, 1947.

WILLIAM M. KELLY, formerly sales representative in the Detroit office, Eaton Mfg. Co., has been made district sales manager in charge of the Axle Division office in Cleveland. Kelly joined Eaton in 1953.

WILLIAM H. FUNSTON, former president of the Firestone Tire & Rubber Co. of Canada, Ltd., has been elected chairman of the Canadian company. Funston has been with Firestone for 33 years and was elected president of Firestone of Canada in 1932.

T. M. MAYBERRY, former executive vice-president and treasurer, has been appointed president of Firestone Tire & Rubber Co. of Canada, Ltd. He has been with the company since 1928.

R. I. RAYCROFT, former general sales manager, has been named vice-president, sales, with the Firestone Tire & Rubber Co. of Canada, Ltd.

WALLACE R. JOHNSON, formerly product engineer with Fairbanks, Morse and Co., is now service instructor-representative, Ford Division, Ford Motor Co. He is currently located in the Chicago district sales office, service department.

WILLIAM GASTON GOVE, junior mechanical engineer with Gulf Oil Corp., has returned to his position after two years' army leave. He is completing a training program at Philadelphia Refinery.

DONALD JAMES MURPHY, formerly director, Van Nuys branch, Lockheed Missile Systems Division, Lockheed Aircraft Corp., has become project systems manager of the division.

JACK CHRISTIAN LATTE is now sales engineer for the Mechanical Drives Co., Inc., Huntington Park, Calif. Formerly he was manager, bearing and equipment department, Bearing and Equipment Co., Ltd.

ROBERT HAWLEY YEAKEY, formerly senior research engineer for Southwest Research Institute, San Antonio, Tex., has joined the Humble Oil and Refining Co. as sales technical service engineer.

Continued on page 104

THERE MUST BE AN EASIER WAY



—AND THERE IS WITH . . .

MIDLAND

WELDING NUTS

The Midland Steel Products Company is constantly developing new, progressive ideas to improve the efficiency of its fine products. It pioneered the *Midland Welding Nut,* for example, and so successful was this application in its own shops that this labor-saving device has been made available to others.

If you are a manufacturer of metal parts or products and have fastening, fabricating or assembling problems, you may find Midland Welding Nuts just the solution you've been looking for. The Nuts are easily welded into position for the lifetime of the product. You can be assured of correct fit, even in the most awkward, hard-to-reach places. Bolts turn easily into the applied nuts. Thus, heretofore two-man operations can be handled by one man in most instances. Weld-nut equipped parts will be preferred by your customers for they will find them cost-saving and trouble-free, cutting down assembly time. Too, you can be sure that your parts will be properly assembled without the risk of rattles.

A few minutes' time in checking the assembly problems of your customers will be profitable to you. Midland Welding Nuts are low in cost, can give you a definite advantage over competition. This practical application is recognized internationally and endorsed by many designers of the finest products.

The MIDLAND STEEL PRODUCTS COMPANY

6660 Mt. Elliott Avenue • Detroit 11, Michigan
Export Department: 38 Pearl St., New York, N. Y.
Automobile and Truck Frames • Air and Vacuum Power Brakes
Air and Electro-Pneumatic Door Controls

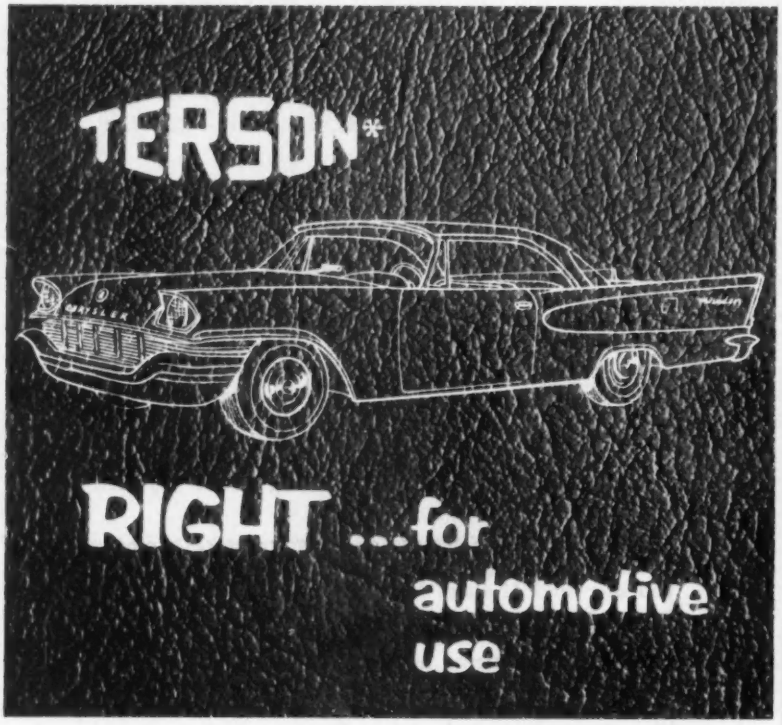
About SAE Members

Continued from page 103

JOSEPH E. HAVENNER, director of engineering and technical services for the Automobile Club of Southern California, Los Angeles, was elected President of the Institute of Traffic Engineers at the 27th Annual Meeting of the organization.

WM. H. MORITZ is now a bus engineer at the Sidney, Ohio, division of Mack Trucks, Inc. Formerly he was an automotive design engineer at Aero-Detroit, Inc.

HERBERT R. ERICKSON has joined the Chemical Division of the Borden Co. as development manager of its resinite department. Formerly he was with the Boeing Airplane Co. where he worked on development and coordination specifications in the fields of plastics, adhesives, and sealants.



Consistent Production in Accordance with your Exact Specifications

Rigid quality controls assure uniformity of every shipment. This, plus Athol's many years of experience and continuous research in the coated fabric field, spells out the reason why this skilled producer is being specified by more and more large users in the automotive industry. Inquiries invited.

VINYL FABRICS FOR AUTOMOTIVE USE

Strategically located plants at Butner, N. C. and Athol, Mass.

ATHOL MANUFACTURING COMPANY

*Reg. U. S. Pat. Off. NEW YORK • ATHOL, MASS. • CHICAGO

HENRY G. HOWELL has been assigned to headquarters, Air Materiel Command, Wright-Patterson Air Force Base, Dayton, Ohio, as mechanical engineer. Formerly Howell served as mechanical engineer, Northern Air Materiel Command, Pacific, located in Japan. In his new post, Howell continues his work in development and technical direction of refrigeration and air conditioning facilities.

KURT B. HOPFINGER's story of famed Dr. Ferdinand Porsche and the Volkswagen which Porsche developed at Hitler's command has just passed into a second printing of its third edition.

Titled "Beyond Expectation," it is a fascinatingly told tale of Porsche's exciting engineering life—and the economic and political webs through which it was lived. Hopfinger, a consulting engineer of Hampton-in-Arden, Warwickshire, England, is a technical correspondent to leading British and foreign automobile journals.

Although he had many postwar talks with Dr. Porsche, Hopfinger's book is based chiefly on "studies of British, French, and German official records and on interviews with persons who were associated with or have witnessed the development of the Volkswagen in various stages."

ROBERT HENRY BEAN has joined the Detroit Diesel Engine Division of General Motors Corp. as a mechanical engineer in its training program. Formerly he was an associate engineer "A" with Douglas Aircraft Co.

NEIL P. FLYNN has become aviation technical manager for the Standard Vacuum-Oil Co. He was formerly a marketing development engineer with the Standard Oil Co.

Flynn served as SAE Metropolitan Section Chairman in 1954.

RAYMOND TAYLOR, formerly final car engineer for Dodge Division, Chrysler Corp., has been made assistant chief engineer for the division. Taylor has been with Dodge since 1949.

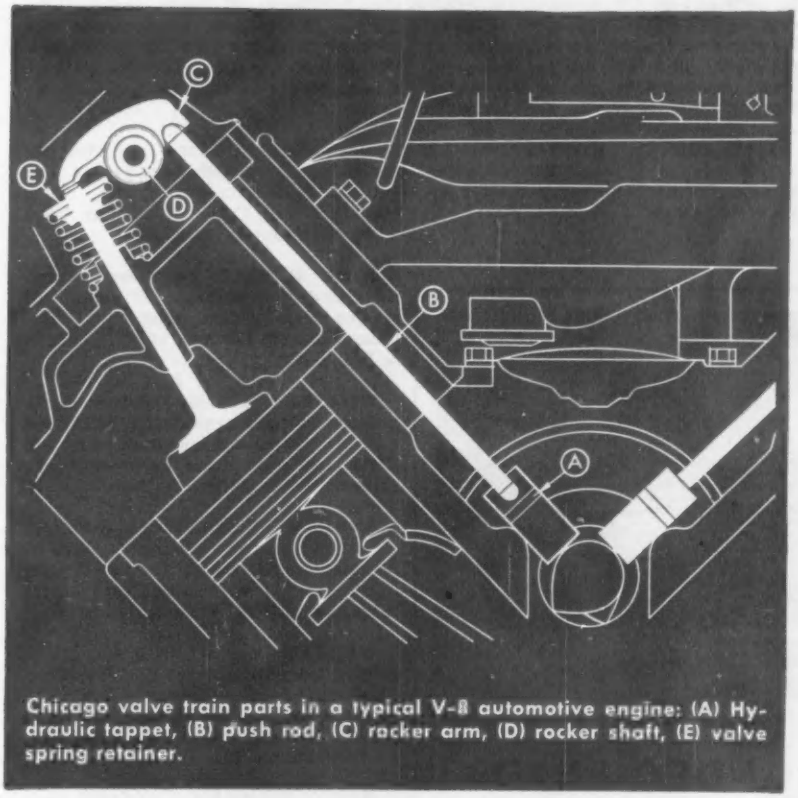
DONALD A. FORMAN, previously assistant chief engineer for Chrysler's Marine and Industrial Engine Division, has become assistant chief engineer for Dodge Division, Chrysler Corp. Forman has been with Chrysler since 1954.

S. F. PALMER, formerly manager, manufacturers sales, has been appointed to the newly created position of assistant to the president, Firestone Tire & Rubber Co. of Canada, Ltd.

NORMAN K. LAMMERS has been appointed a supervising engineer in the research department at Caterpillar Tractor Co. Lammers has been with the company since 1950 and formerly was a research engineer.

Continued on page 106

For all engines - - -



Chicago valve train parts in a typical V-8 automotive engine: (A) Hydraulic tappet, (B) push rod, (C) rocker arm, (D) rocker shaft, (E) valve spring retainer.

Passenger cars



Trucks



Tractors



Diesels



Aircraft



Everything you need in valve gear

from CHICAGO

Here at Chicago you'll find a single source for everything you need in valve gear. These specialized facilities are solving problems and saving money for leading engine manufacturers . . . and can do the same for you.

Design and Engineering—at Chicago you'll find valve gear engineering experience in depth . . . men who understand your problems and will work with your engineering staff in designing cam shafts and complete valve gear assemblies for any type of engine.

Manufacturing—Chicago is a leading manufacturer of valve train parts. Our complete line includes precision-made hydraulic and mechanical tappets; push rods in both lightweight tubular and solid styles; valve adjusting screws including new self-locking screws that cut assembly costs; valve spring retainers; rocker arms and rocker shafts.

Testing—we have complete laboratory and engine testing facilities.

For the full story of how we can serve you, write our Tappet Division.

THE CHICAGO SCREW COMPANY

ESTABLISHED 1872 • DIVISION OF STANDARD SCREW COMPANY

2701 WASHINGTON BOULEVARD, BELLWOOD, ILLINOIS

About SAE Members

Continued from page 104

D. J. ROSELLE of The Standard Oil Co. of Ohio recently co-authored and presented a paper on "The Contractor's Partner—The Lubricant Supplier" at the National Lubricating Grease Institute's national meeting.

BERNARD E. TOBEN has joined the International Business Machines Corp. as assistant to the manager of engineering, Electric Typewriter Division. Formerly he was with the company as manager of laboratory manager's staff, product development laboratory, Poughkeepsie, N. Y.

WALLACE A. HOFTIEZER has joined Boeing Airplane Co., as a designer. Formerly he was project engineer, J. I. Case Co., Racine, Wis.



Exclusive
BONDED-LEAD CONSTRUCTION

Makes Vision-Aid The Most Rugged Passenger Car Headlamp Ever Built!

New standards of lighting dependability are created by the new Tung-Sol Vision-Aid Headlamp. A spot-weld bond, an exclusive Tung-Sol feature, joins two lead wires inside the reflector of the headlamp. Result: a more stable filament assembly that is far less affected by shock and vibration.

Exhaustive laboratory impact tests clearly reveal that these new headlamps stand up under more service abuse than any other headlamp on the market.

Tung-Sol Headlamps conform fully to industry standards: E-Z Aim Platforms provide quicker, simpler aiming and the improved passing beam which gives up to 80 extra feet of seeing distance make Tung-Sol Vision-Aid Headlamps the finest for both 6 and 12-volt service. You can provide no better illumination for your line of automobiles.

The Vision-Aid 5440-S Headlamp for truck and bus service includes the spot-welded leads, E-Z Aim Platforms and the longer range passing beam as well as re-proportioned filaments, ceramic ruggedizing collar and anti-shock fog cap mounting.

TUNG-SOL® VISION-AID HEADLAMPS
5040-S 6-VOLTS 5400-S 12 VOLTS
5440-S 12-VOLTS TRUCK

Tung-Sol Electric Inc., Newark 4, New Jersey

Sales Offices: Atlanta, Ga.; Columbus, Ohio; Culver City, Calif.; Dallas, Tex.; Denver, Colo.; Detroit, Mich.; Melrose Park, Ill.; Irvington, N. J.; Newark, N. J.; Philadelphia, Pa.; Seattle, Wash. Canada: Montreal, P.Q.

R. CHELLAPPA has joined the special-purpose machine design section of the Northwest Machine Design Co., Ltd., at Kenton near London. He was formerly with the Tata Mercedes-Benz Division of the Tata Locomotive and Engineering Co., Ltd., at Jamshedpur, India.

CLARENCE O. GOFF has recently resigned as general manager of the William D. Gibson Co. Division, Associated Spring Corp. Goff has been with the company since 1918.

JOHN F. BECK has been named metallurgist supervisor of technical service, metallurgical department, Tubular Products Division of the Babcock & Wilcox Co.

WILLIAM D. PERREAULT, formerly military sales representative, Lockheed Georgia Division, Lockheed Aircraft Corp., has been made export military sales manager for the division.

ANDREW M. MAXWELL, formerly assistant project engineer, Wright Aeronautical Division, Curtiss-Wright Corp., has joined the Civil Aeronautics Administration in Washington, D. C.

WILLIAM G. MYERS has been named sales director of the Lockheed Marietta Sales Division, Lockheed Aircraft Corp. Myers, formerly director of military sales, has been with Lockheed since 1941.

HENRY C. HODGES, formerly resident director, Detroit Arsenal Test Operation, Wetmore Hodges & Associates Inc., is now president of Hodges Transportation, Inc., Redwood City, Calif.

HAROLD KENNETH BARTE is now a design engineer for the Boeing Airplane Co. Formerly he was with the Engineering Staff, General Motors Corp., as senior project engineer.

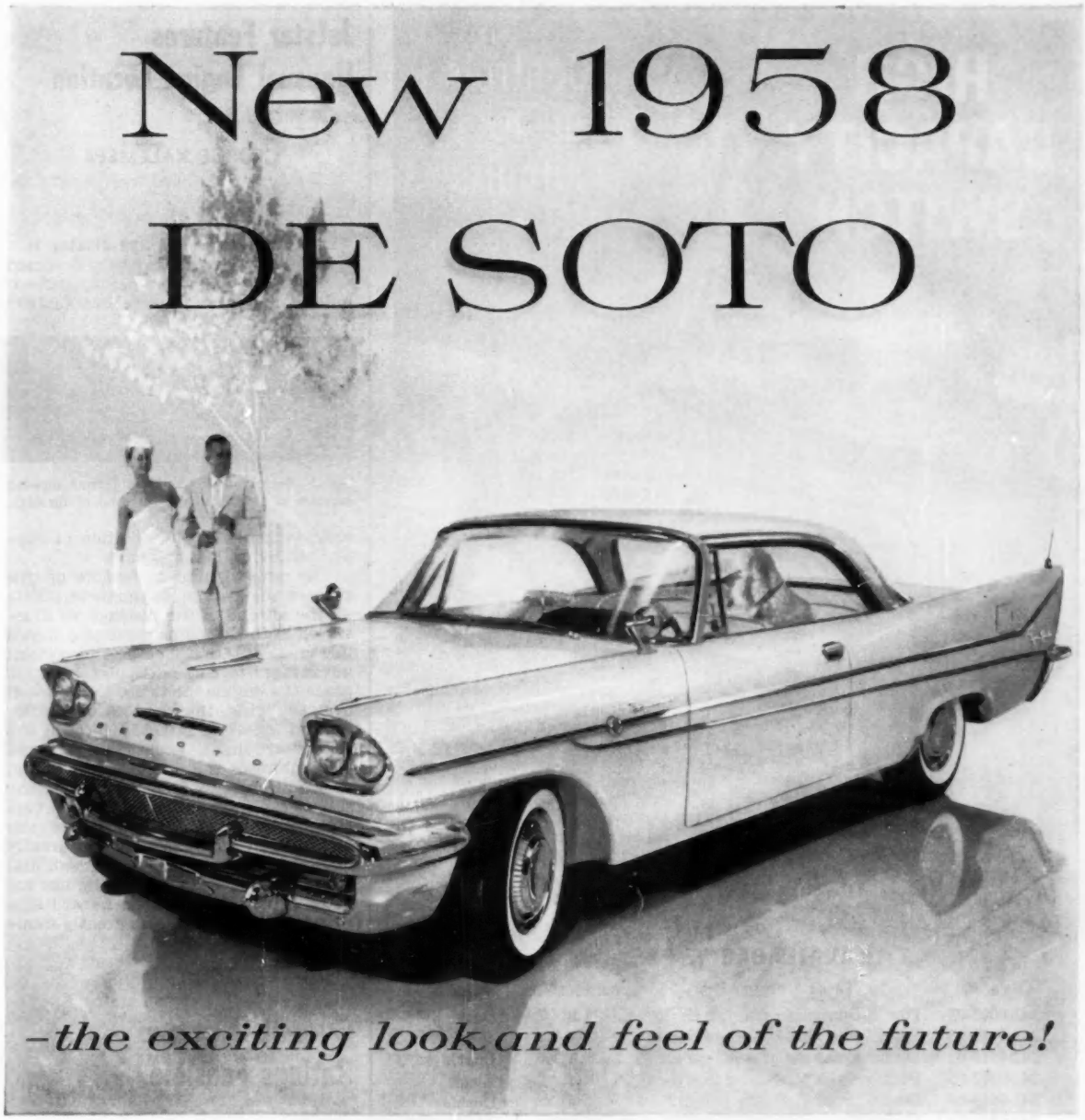
ROBERT G. OAKLEY, formerly assistant to the vice-president in charge of the Autocar Division, White Motor Co., is now manager of the Cleveland branch of the company.

J. J. PIRNAT, formerly field engineer, Standard Oil Co., has become maintenance superintenedent for the Red Eagle Corp., Columbus, Ohio.

JAMES P. BROWN has been made manager of west coast operations for the Grand Rapids Division, Lear, Inc. He will continue as west coast area contracts manager, and in addition will administer Lear's western district field service activity and western branch. He has been with the firm 11 years.

JOHN E. ROWE has become executive vice-president of the Tomkins-Johnson Co. Formerly he was vice-president of the Ross Operating Valve Co.

New 1958 DE SOTO



Fireflite 2-door Sportsman by De Soto. Clothes by I. Magnin

Here is the flight-sweep styling of the future—functional outside, spacious and modern inside.

Here is the power of the future—a new engine of advanced design. Quiet, economical and powerful, it brings a new smoothness to driving.

Here is the ride of the future—new Torsion-Aire is air-borne smooth, with unrivaled roadability. No extra cost!

Here is the convenience of the future—driving is push-button simple; parking is fingertip easy.

Get a glimpse of the future at your De Soto dealer's today.

De Soto Division, Chrysler Corporation

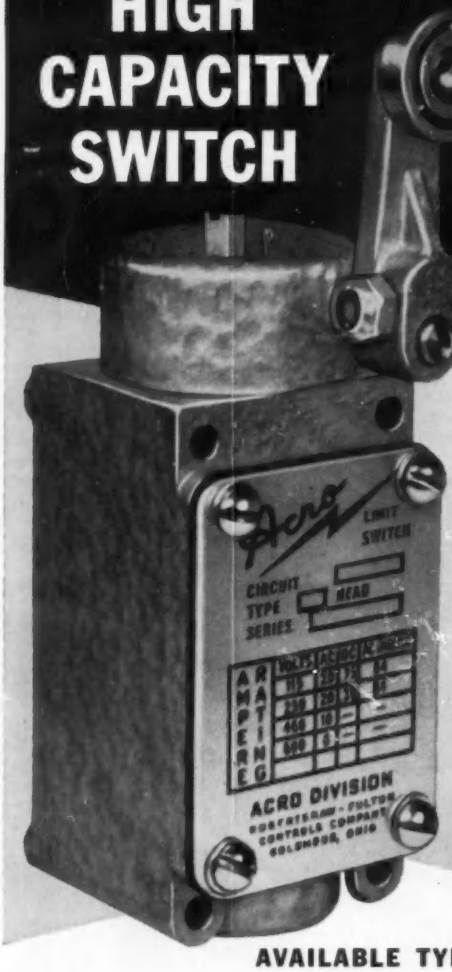
New wide range of prices...starts close to the lowest. FIRESWEEP—big-value leader for 1958. FIREDOME—medium-priced pacemaker. FIREFLITE—the ultimate in luxury.

HIGH CAPACITY SWITCH

Controls up to 4 circuits

•

DUST, OIL-TIGHT
LONG LIFE
VERSATILE
LONG OVERTRAVEL



Machine tool and other equipment applications are "naturals" for this Acro high capacity switch, which can control up to four separate circuits on either pilot or line duty. Actuator is adjustable 360° in two planes.

ELECTRICAL RATING

2 H.P. 230 Volts A.C.
1 H.P. 115 Volts A.C.
20 Amps—250 Volts A.C.

Two types available: Double Action Type actuates switch contacts when actuator is moved either side of "at rest" position. Single Action Type operates from one side of "at rest" position only. Both are designed for long life under heavy use.

AVAILABLE TYPES

Catalog No.	Circuit Arrangement	No. Terminals	Action
242-0003-03	Four circuits (two open, two closed)	8	Double
242-0011-03	Four circuits (two open, two closed)	8	Single
242-0010-03	Double circuit (one closed, one open)	4	Double
242-0012-03	Double circuit (one closed, one open)	4	Single
242-0019-03	Double circuit (normally closed)	4	Double
242-0017-03	Double circuit (normally closed)	4	Single
242-0020-03	Double circuit (normally open)	4	Double
242-0018-03	Double circuit (normally open)	4	Single

Write for complete information and application engineering help. Mention ACRO Machine Tool Switch!

Mr. Controls

Robertshaw-Fulton
CONTROLS COMPANY

ACRO DIVISION • Columbus 16, Ohio

In Canada: Robertshaw-Fulton Controls (Canada) Ltd., Toronto

Jetstar Features Unusual Engine Location

Based on talk by

GEORGE KALEMBER
Lockheed Aircraft Corp.

(Presented before SAE Atlanta Section)

THE Lockheed model 329 Jetstar is a 4-engine utility jet transport designed to carry 10 passengers 1500 nautical miles (which can be extended to 1850 nautical miles by the addition of slipper tanks), at 500–550 mph.



Fig. 1—Prototype of Lockheed Jetstar showing location of powerplants on aft end of fuselage.

The most significant feature of this plane is the location of the powerplants on the aft end of the fuselage, as illustrated in the 2-engine prototype shown in Fig. 1. There are several important advantages to this particular location. Since the engine inlets are located well over the wing, the chances of picking up and ingesting ground debris in the engines are slight. Location in this area also enhances the operational comfort in the aircraft by greatly reducing the sound level. The compressor and turbine sections are located aft of the fuselage pressure vessel, thereby greatly reducing the hazards of compressor and turbine blade loss. With engines located in this position, fire hazard in a wheels-up landing is also greatly minimized.

Over-100-Octane Ratings Feasible

Based on paper by

E. F. MARSHALL
and
C. S. GILBERT, JR.
Sun Oil Co.

FUELS up to about 105 Research octane number—or about 110 octane number (road rating)—can be rated satisfactorily in 12/1 compression ratio cars using either Modified Uniontown or Modified Borderline procedures. This is one indication developed from recent tests made with 1956 production engines of three different types modified to produce a 12/1 ratio.

Besides fairly well defining and determining the magnitude of road-rating problems with 12/1 compression ratio cars, this study pointed up cor-

Continued on page 110



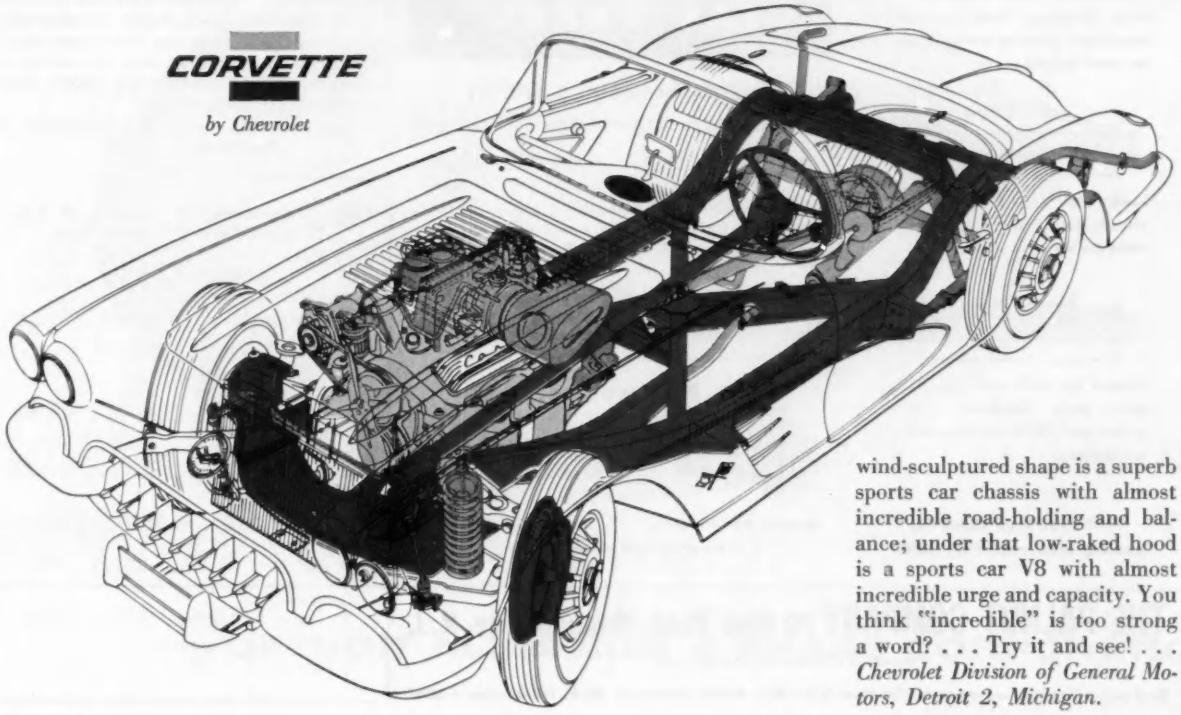
corvette for '58

CORVETTE
by Chevrolet

Brand new . . . and bred for action!

This is a very special car for special people with very particular requirements. We'll grant you it is as sleekly handsome a machine as ever whispered down a boulevard, with an individual flair that is shared by no other. And we'll also concede that its road manners are impeccable, that it moves with a glove-leather suppleness that is obedience personified.

But the real difference between the 1958 Corvette and any other American car is this: It is an authentic sports car. Under that



wind-sculptured shape is a superb sports car chassis with almost incredible road-holding and balance; under that low-raked hood is a sports car V8 with almost incredible urge and capacity. You think "incredible" is too strong a word? . . . Try it and see! . . . *Chevrolet Division of General Motors, Detroit 2, Michigan.*

CYCLON · CYCLON · CYCLON · CYCLON · CYCLO

relations that might be expected between laboratory and road ratings of high-octane fuels in these cars.

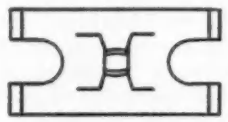
Indications of the latter sort included the following:

1. Reproducibility of road rating results on fuels in the 100–105 Research octane-number range is comparatively good; about as good as on fuels below 100 octane number.
2. Relationships can be established between road and laboratory ratings which either compare with or extend previous correlations in the 90–100-octane-number bracket.
3. The clarity of the knock, time consumed per rating, and individual operator's ability to rate are all about equal to those in the area below 100 octane number.

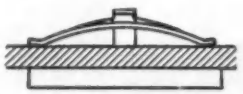
To Order Paper No. 259 . . . on which this article is based, see p. 5.

THIS Fastener works every time!

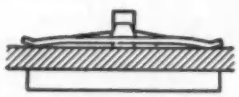




Four Gripping Teeth provide maximum gripping action, even on hard chrome studs.



Long, High Spring Arch maintains tension in service; compensates for wear on parts.



Turned Up Ends slide smoothly over body deadener, radio grilles and plastic surfaces without digging.

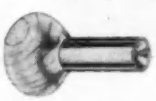
Write for free samples, stating size, material, finish

TYPE "H" PUSHNUT® FASTENERS

For unthreaded studs of Ornaments — Nameplates — Emblems

The improved design of Type "H" PUSHNUTS brings you ease and speed of application—savings on assembly costs—security of fastening never before achieved on unthreaded studs. With all their advantages, PUSHNUTS are very low in price. Made of tempered spring steel in plain, parkerized and cadmium finishes. Sizes for 1/16", 3/32" and 1/8" studs. Have our fastening engineer demonstrate—or run your own tests.

Fast, Positive Assembly



Manual Applicators



Power Tool Shanks

Magnetic and non-magnetic

THE PALNUT COMPANY 70 Glen Road, Mountainside, N. J.

Subsidiary of United-Carr Fastener Corp.

Regional office and warehouse: 730 West Eight Mile Road, Detroit 20, Mich. Tel. JOrdan 4-6087

Gas Turbine Fuels And Avgas Compared

Based on talk by

T. F. DAVIDSON

Wright Air Development Center, USAF

(Presented before SAE South Texas Section)

THE fuels used in gas turbines are as different from those used in reciprocating engines as are the two types of engines themselves. For example, "recips" require fuel of high antiknock performance, gas turbines have no such requirements. Also, since gas turbine powered aircraft fly much higher than piston-engine planes, much stricter control of fuel volatility is required for the gas turbine fuel.

Table 1 shows the more important properties of the two fuels. Note that two gas turbine fuels are given—the JP-4, used by the Military, and a kerosene type, such as used by the Viscount. The reason is that, at this time, it is impossible to tell which way commercial specifications will go. Both fuels have their good and bad points, and agreement has not yet been reached on commercial fuel specifications.

The boiling range (initial boiling to end points) and the Reid vapor pressure of fuels are important because they are indicative of the ease of ignition, boil-off, and vapor-lock tendencies of a fuel. For example, a fuel with a low initial boiling point and high Reid vapor pressure will be one which is easy to ignite but prone to vapor lock and boil-off. Therefore, as can be seen from an ease-of-ignition standpoint, Avgas is the best of the three fuels and kerosene is the worst, but the order is reversed when considering vapor lock and boil-off tendencies.

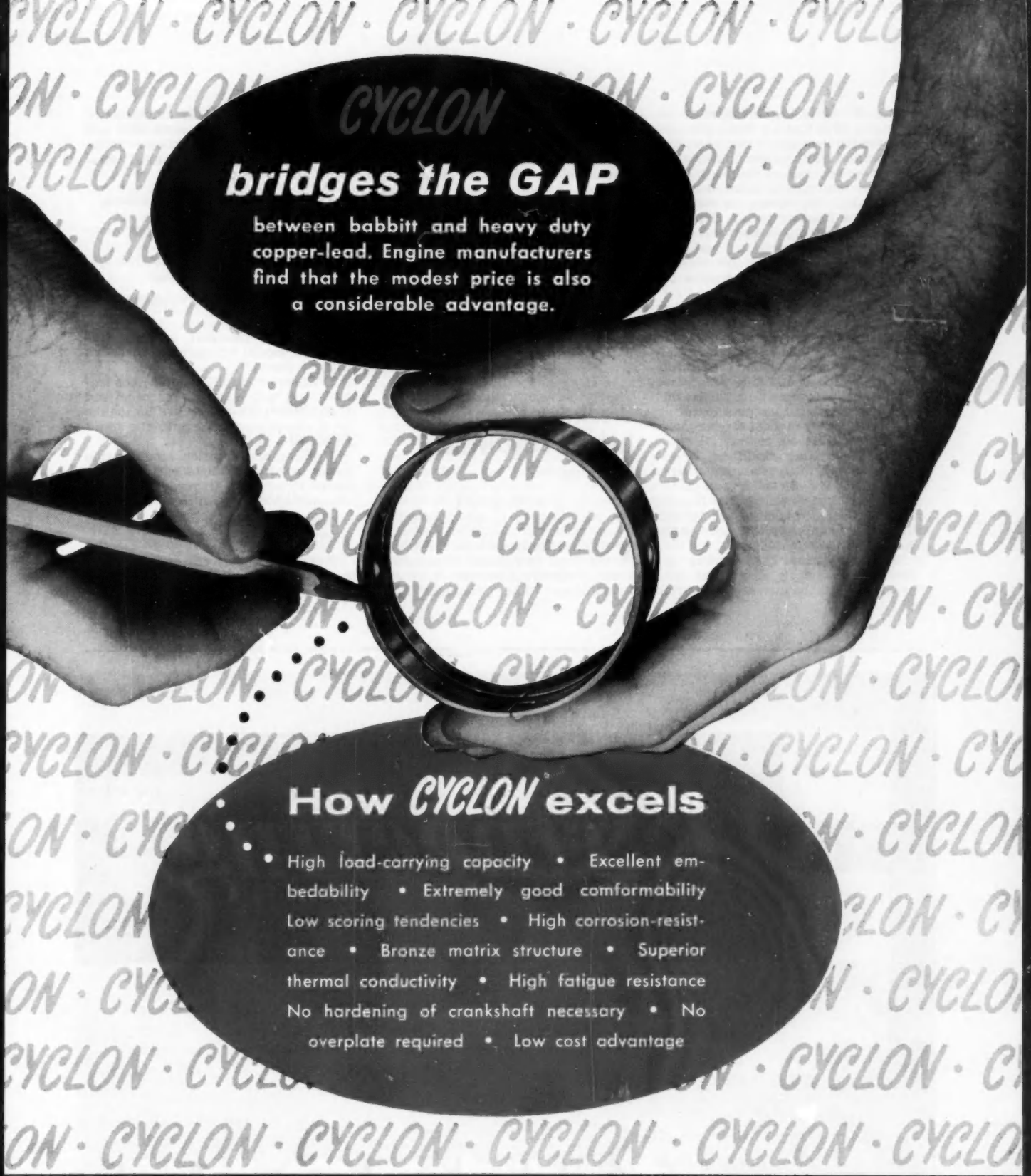
The freezing point is considered a

Continued on page 112

Table 1—Comparison of Properties of Avgas, JP-4, and Viscount Kerosene Fuels

	Avgas[b]	JP-4	Viscount Kerosene
Boiling Range, F	110–310	142–468	350–525
Reid Vapor Pressure, psi	6.6	2.6	0
Freezing Point, F	< −76	< −76	< −40
Limits of Flammability,[a] F	−20 to +20	−25 to 80	100 to 180
Heat Content, Btu/lb	18,921	18,685	18,585
Gravity, lb/gal	5.9	6.4	6.8
Heat Content, Btu/gal	111,634	119,584	126,485

[a] At atmospheric pressure.
[b] Grade 100/130 fuel.



DETROIT ALUMINUM & BRASS CORPORATION

DETROIT 11, MICHIGAN

MANUFACTURERS OF ORIGINAL EQUIPMENT SINCE 1925

good index of the low-temperature performance of a fuel. A fuel with a low freezing point means it can be pumped and ignited easily at low temperatures. An oft-quoted rule of thumb is that a fuel can generally be pumped and ignited with relative ease to within 10 deg of the freezing point. Therefore, from a low-temperature standpoint, kerosene is the poorest fuel and Avgas and JP-4 are a considerable improvement as regards low-temperature performance over kerosene.

The limits of flammability (the temperature range over which a fuel will ignite in the presence of a spark upon coming to equilibrium with the atmosphere) is an extremely important property from a fuel handling and safety standpoint. In this regard, Avgas mixtures under normal temperature conditions are too rich and kerosene mixtures too lean to ignite. However, under these same conditions JP-4 is almost always in the flammable range. This, therefore, dictates that caution be exercised in handling JP-4 fuel, but when proper precautions are followed JP-4 is easy and safe to handle, transfer, and load.

The gravity and heat content of a fuel are extremely important since gravity affects the aircraft gross weight and, when coupled with the fuel heat content, is the prime factor in determining aircraft range. From these standpoints the fuels, in order of merit, rate as follows: Avgas, JP-4, and kerosene.

One question that invariably arises is, "Can a gas turbine be operated on Avgas?" The answer is yes! This answer should, however, be qualified by stating that prolonged operation, say 50–100 hr, of a gas turbine on Avgas will lead to loss of turbine efficiency, deterioration of fuel system components, and other performance losses, due to the tel in the fuel.

Predicting Vibration Isolator Effectiveness

Based on paper by

A. O. SYKES
David Taylor Model Basin

MOUNT effectiveness is the parameter used to evaluate vibration isolators between machines and their foundations. The parameter is the complex ratio of velocity amplitude of the machine mounting point with and without the isolator in place. Complete analytical and graphical solutions are developed for:

- Rigid and nonrigid foundations.
- Rigid machines.
- Weightless spring-dashpot isolators.
- Continuous isolators (having distributed mass and elasticity).

Conclusions for the weightless isolator are:

1. Barring resonant exciting frequencies, mount effectiveness increases with "softness."
2. Vibration amplification by the isolator will not occur if machine and foundation impedances are springlike or if one is springlike and the other resistive.
3. Maximum vibration amplification by an isolator is controlled by its loss factor (product of frequency times resistance divided by stiffness).

Continuous isolator investigations show:

Weightless performance is approached at frequencies with wavelengths 10 or more times the largest



dimension of the isolator.

Independent of foundation impedance, effectiveness is less than weightless theory if the isolator is at its lower standing-wave frequencies. A higher damping factor tends to improve the effectiveness.

Greater effectiveness than predicted by the weightless theory is possible if the exciting frequencies are much higher than the isolator frequency constant (unit wave propagation velocity).

To Order Paper No. 201 . . . on which this article is based, see p. 5.

Weapon System Cost Paced by Ground Support

Based on paper by

HOWARD B. SIMKINS
Lockheed Aircraft Corp.

FUTURE heavy bombardment air vehicles will be larger, heavier, more complex in design, fly higher and longer, and consequently cost more. Inevitably ground support will follow the same road.

Maintenance of ground support equipment will become increasingly important because complexity and high cost will limit the volume of spare parts. Unless we are careful, it may be necessary to have checkout equipment to check out the electronic subsystem checkout equipment. If this trend continues, checkout equipment may become more complex than the original airframe subsystems. The end result can be disastrous unless we have personnel suitably trained to maintain both weapon system and ground support equipment.

The maintenance problem is aggravated by the continuing loss of technically trained personnel from the armed services and a steadily dropping reenlistment rate. Possible solutions to this problem are to lengthen enlistment period, offer enticing bonuses for re-enlistment, increase pay scale on a skill basis, or use airframe and subsystem contractor personnel. The trend is toward using the last mentioned.

Maintenance and supportability concept requirements will lead to more automatic devices and more fixed installations for specific functions. With combat ready status and primary turnaround times being of prime importance, the need for automation and fixed installations must be realized and kept foremost in designers' minds from the weapon system preliminary design phase to the operational article.

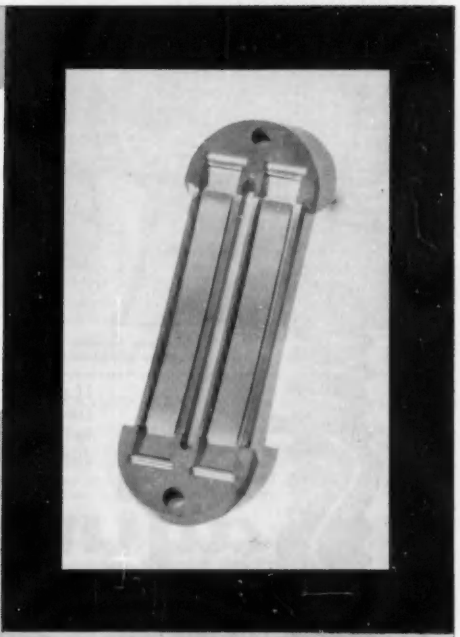
Some support units will be of such size, weight, and shape as to require their being built as an integral part of specific fixed facilities. Engine test cells now in use and missile launching equipment with its blockhouse and integral instrumentation already fall into this category. The trend is expected to continue and air vehicle designers need to be aware of it in the development of subsystems and their supportability requirements.

Operational planning for future weapon systems must begin during preliminary design phases since decisions regarding planning can affect the development of the air vehicle itself. The long lead times required for logistic support make this imperative. On the logistic side, supportability items must be available now and not have to be brought in from some outside depot. Such items as pipe line times must be

Continued on page 115

ANOTHER EXAMPLE OF THE BENEFITS OF B-N *PARTNEERING*

Originally cast and machined, this compressor valve plate component cost over $1.00. *B-N Partneering* effected both product improvement and substantial cost savings by redesign and production in Quali-SINT—one of the many methods and facilities available at Burgess-Norton. The part now, with closer tolerances, greater uniformity and better performance, costs 27 cents.



If you are designing parts for future products, buying for immediate production, or deciding whether to "make or buy"—B-N *Partneering* can help you. Send prints, specifications, or call us for specific information.

B-N Norton Mfg. Co. Geneva, Illinois

FOR OVER 50 YEARS



ACTUATE OR POSITION IT BETTER WITH

SAGINAW b/b SCREWS

6 decisive advantages reduce manufacturing problems and costs:

FORWARD: When rotary motion is applied to the screw, the b/b nut is driven along the axis of the screw, changing rotary motion to linear motion.

FORWARD: When rotary motion is applied to the b/b nut, the screw is driven along its longitudinal axis, changing rotary motion to linear motion.

1 **POWER SAVINGS.** Operating with over 90% efficiency, Saginaw b/b Screws permit much smaller motors with far less drain on electrical systems, and also simplify circuitry.

2 **SPACE SAVINGS.** Saginaw b/b Screws themselves are compact. They permit smaller motors and gear boxes and eliminate auxiliary equipment required by hydraulics.

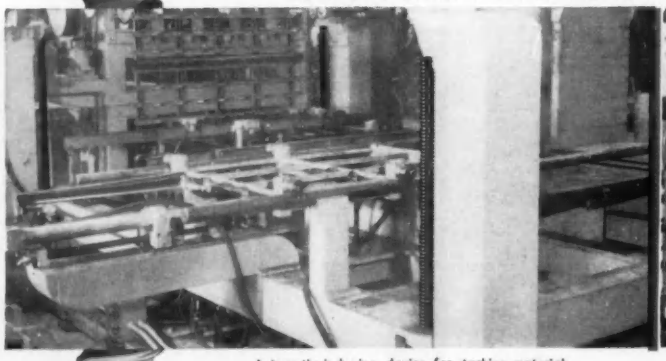
3 **DEPENDABLE PERFORMANCE.** Saginaw b/b Screws are far more reliable than hydraulics or pneumatics. Gothic-arch grooves, yoke deflectors and multiple circuits provide added assurance.

4 **PRECISE POSITIONING.** Saginaw b/b Screws will position components far more precisely than hydraulics or pneumatics; tolerances on position are held within .0006 in./ft. of travel.

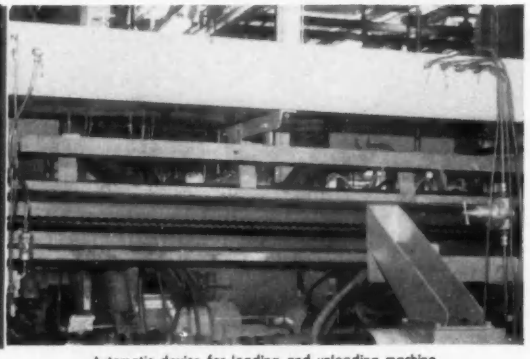
5 **TEMPERATURE TOLERANCE.** Normal operating temperature for Saginaw b/b Screws is from −75°F. to +275°F. But in selected materials, they will function efficiently at temperatures as high as +900°F.

6 **LUBRICATION.** If lubrication fails the Saginaw b/b Screw will still function with remarkable efficiency. Units have been built and qualified for operation without lubrication.

TYPICAL AUTOMATION APPLICATIONS



Automatic indexing device for stacking material. Saginaw b/b Screw used to raise and lower table.



Automatic device for loading and unloading machine. Saginaw b/b Screw used to save power and space.

If you would like further details on the use of Saginaw b/b Screws to increase the efficiency of plant operations, or specific application recommendations for your individual processes, experienced Saginaw engineers are at your service without obligation. Just write or phone us your requirements, or fill in and mail the handy coupon below.

Saginaw

ball bearing Screw

SAGINAW STEERING GEAR DIVISION OF GENERAL MOTORS • SAGINAW, MICHIGAN

WORLD'S LARGEST PRODUCER OF BALL BEARING SCREWS AND SPLINES

SEND TODAY FOR FREE 36-PAGE ENGINEERING DATA BOOK . . .

or see our section in Sweet's Product Design File



Saginaw Steering Gear Division
General Motors Corporation
b/b Screw and Spline Operation
Dept. 1E, Saginaw, Michigan

Please send new engineering data book on Saginaw b/b Screws and Splines to:

NAME _____

COMPANY _____ TITLE _____

ADDRESS _____

CITY _____ ZONE ____ STATE _____

decreased to an absolute minimum.

The establishment of lead air material areas in the proximity of future operational bases would eliminate long pipe line times, reduce the number of spares, reduce packaging requirements, and allow on-base maintenance and overhaul of subsystem components.

Aircraft now in the preliminary design phase will require more facilities of special design than those now current. In addition, base complexes will become ever larger and facility separation distances will be greater due to contemplated operational environments. Here again, the long lead times necessary for facility design, construction, and furnishing present the weapon system prime contractor with the tremendous responsibility of having sufficient satisfactory facilities available when needed.

Three of the new operational environments now foreseen in the next decade are increased temperatures, higher operation noise levels, and radiation. Ground support equipment must be designed to operate in these new environments. Equipment for some future weapon systems must operate in environments up to 600 F, while noise levels will be so high as to cause structural damage to ground support equipment as currently conceived.

Presumably, nuclear-powered aircraft will be a reality within a decade. For their maintenance and support, equipment such as robot equipment and remotely controlled manipulators with integral remote closed-circuit stereo TV viewing devices will be a necessity.

To Order Paper No. 207 . . . on which this article is based, see p. 5

Equipment Fragility Reporting Inadequate

Based on paper by

R. S. BRADFORD

Calif. Institute of Technology

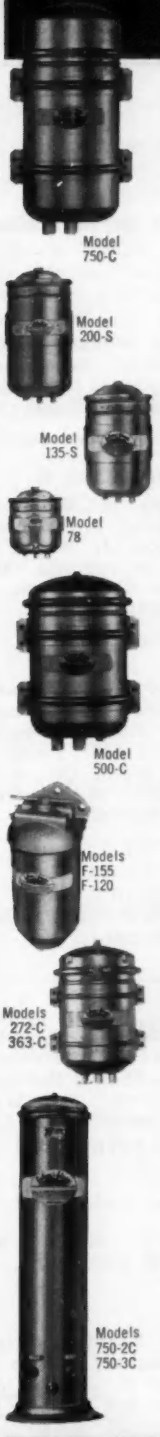
THE method of rating the fragility of an instrument is the stumbling block in the design of vibration isolators. The common system is to give an amplitude-frequency curve at each of the mounting points. This assumes a brittle rather than fatigue failure and does not account for complex-wave excitation. For instance, the excitation might be composed of several different sinusoidal vibrations **plus** random vibration produced by the exhaust gases of a jet engine.

Two needed solutions are:

- The effect on fatigue strength of a vibration of randomly varying amplitude and frequency.
- A method of reporting fragility of equipment as a single curve or probability that will encompass complex-wave excitation.

To Order Paper No. 196 . . . on which this article is based, see p. 5.

THERE'S A LUBER-FINER MODEL FOR EVERY TYPE OF ENGINE FOR EVERY TYPE OF OIL!



ONLY A GENUINE Luber-finer PLUS A GENUINE LUBER-FINER PACK

CAN GIVE THE EXCLUSIVE PATENTED FILTERING PROCESS THAT HAS MADE LUBER-FINER THE **Standard Of The Industry Since 1936**

MODELS 78, 135-S, 200-S, featuring single-bolt lid, screw-in type pack, and overall compact design for use where space is limited. These Models provide the ultimate in filtration for passenger cars, small trucks and tractors, and other similar engines up to 5-quart, 6-quart, and 7-quart crankcase capacities.

MODELS 272-C and 363-C, featuring the Luber-finer single-bolt lid clamp, O-Ring lid gasket, screw-in type pack, and rugged construction throughout. Designed for heavy-duty service on gas, gasoline or diesel engines up to 3-gallon and 4-gallon crankcase capacities.

MODELS 500-C and 750-C, featuring the Luber-finer single-bolt lid clamp O-Ring lid gasket, large-capacity packs, and extra rugged construction to withstand the most severe service. Designed for use on gas, gasoline or diesel engines up to 5-gallon and 8-gallon crankcase capacities. Also widely used on fuel lines, hydraulic oil systems, and many other industrial applications.

MODELS 750-2C & 750-3C, featuring the Luber-finer single-bolt lid clamp, O-Ring lid gasket, and multiple packs for extra large capacity. Available with either wall or floor mounts for industrial use on engines up to 35-gallon sump, fuel lines up to 15 GPM, hydraulic oil systems up to 450 gals. For larger capacities, two or more Units can be connected in parallel.

MODELS F-120 and F-155, for gasoline and diesel fuel lines on mobile, stationary, or marine applications. Extremely efficient in removing impurities and contaminants from fuel. Single Units will handle flow rates from 0.5 to 1.0 GPM on suction or gravity flow. For larger capacities, connect two or more Units in parallel, or install on pressure-side of fuel pump.



GENUINE LUBER-FINER PACKS available in two types...

DIESELPAK — Expressly designed and recommended for use with all detergent-type compounded oils. Has the abilily to remove the most finely dispersed contaminants without removing or affecting the additives.

REFINING PACK — For use on straight mineral oil, synthetic oils, diesel fuel oil, hydraulic fluids, etc.

★ THERE IS A GENUINE LUBER-FINER MODEL FOR PASSENGER CARS, TRUCKS, TRACTORS, STATIONARY AND MARINE ENGINES, HYDRAULIC OIL SYSTEMS AND MANY INDUSTRIAL APPLICATIONS.

WRITE FOR COMPLETE INFORMATION TO DEPT. 402

LUBER-FINER, INC. 2514 S. Grand Ave., Los Angeles 7, Calif

YOU CAN DEPEND ON

SPHERCO®

BEARINGS & ROD ENDS



Quality SPHERCO Bearings and Rod Ends are precision built for superior performance

There are SPHERCO Bearings and Rod Ends for every application! There is a SPHERCO Engineer in your area to help you with your problems.



YOU'LL WANT FULL INFORMATION ON SPHERCO FEATURES . . . WRITE TODAY FOR THIS NEW CATALOG

NAME_____

TITLE_____

COMPANY_____

ADDRESS_____

CITY_____ STATE_____

SPHERCO

A PRODUCT OF
SEALMASTER BEARING DIVISION
STEPHENS-ADAMSON MFG. CO.

8 RIDGEWAY AVE. • AURORA, ILL.

New Members Qualified

These applicants qualified for admission to the Society between October 10, 1957 and November 10, 1957. Grades of membership are: (M) Member; (A) Associate; (J) Junior.

Alberta Group:

William George Anderson (A).

Baltimore Section:

Paul E. Henninger, Sr. (M). Gilbert L. Wolf (J).

Canadian Section:

Keith Blackburn (J), Francis E. Conlin (A), Theodor William Haiplik (J), Edwin A. Kozicki (J), James Warner Marshall (A), Frederick O. Popham (M), William Philip Schoenau (A), G. Stanley Town (J).

Central Illinois Section:

Walter F. Anderson (M), Hubert D. Boggs (M), Alexander P. Brouwers (M), Harrison F. Cox (J), Wesley C. Leveck (M), Loren N. Peterson (M), Andrew B. Pulliam (M), Lowell J. Wuthrich (A).

Chicago Section:

Robert E. Coates (J), Ralph H. Horn (J), Hubert N. Leipzig (J), Ronald Vincent Miskeli (J), Trygve S. Neprud (J), Robert W. Olsen, (M), Frank J. Seneses (J), Jay R. Sturm, (M), E. F. Tallackson (A), James R. Woodrow (J).

Cincinnati Section:

Paul H. Blessing (A), James F. Brown (M), Robert L. Hardin, Jr. (M), Howard G. Mallinger (A).

Cleveland Section:

F. H. Brysacz (M), Forrest L. DuRant, Jr. (M), Robert E. Forrester (M), Lawrence Gene Gatton (J), Sheldon Glickhause (J), Warren B. Grote (M), Robert C. Holmgren (J), Orris H. Johnson (M), Charles W. Nehr (J), Andrew P. Papanek (M), Robert E. Schmitt (J).

Colorado Group:

Thor B. Groswold (J), Harry M. St. John (M), Donald E. Yadon (J).

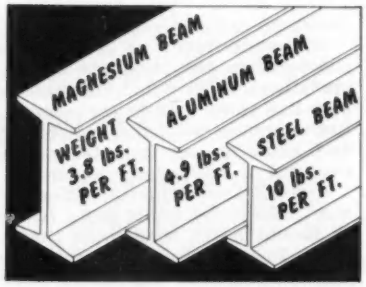
Dayton Section:

W. R. Alley (M), David Biermann (M), Harry A. Nelson (J), Martin A. Rumel (J), Walter R. Saupe (J), Richard H. Sommer (J).

Detroit Section:

Peter G. Anderson (M), George E.

Continued on page 118



THESE BEAMS ARE OF EQUAL STIFFNESS. Relative Stiffness in Bending, based on rectangular beams of constant width and equal weight: STEEL 1.0; ALUMINUM 8.9; MAGNESIUM 18.9.

Maximum stiffness with minimum weight

Of all structural metals, magnesium has the highest stiffness-to-weight ratio.

Modulus of elasticity for magnesium is 6.5 million pounds per square inch; for aluminum 10 million; and for steel 29 million. Stiffness is resistance of a material to deflection under a given load within the elastic limit. The amount of such deflection is proportional to the amount of inertia of the beam multiplied by the elasticity modulus of the material.

When a part previously of steel or aluminum is being redesigned for magnesium, the moment of inertia must be increased in proportion to the lower elastic modulus of magnesium to obtain the same stiffness. But – the moment of inertia increases as the cube of the thickness of the beam. So–very little added thickness tremendously increases stiffness. The net result is a slightly thicker section for the magnesium part, and a marked reduction in weight.

This is why magnesium is used for floor beams in airplanes; for radar feed horns and reflectors where low inertia and high stiffness are required; and for hundreds of other similar applications.

B&P engineers will help you redesign in magnesium. B&P offers the magnesium industry's most complete facilities for fabrication and assembly. Your inquiry will bring a descriptive booklet.

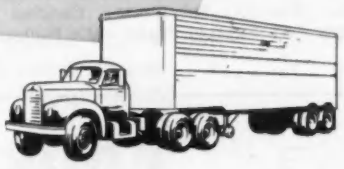
BROOKS & PERKINS, INC.

1922 West Fort Street
Detroit 16, Mich.

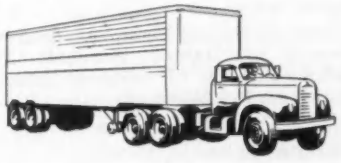
D-2

Only MIDLAND Goes Beyond ICC Braking Requirements With All These Positive-Plus Features!

Have you converted your tractor-trailers to comply with the new ICC emergency braking regulations? If not, be sure to specify Midland equipment, for only Midland gives you all these EXTRA SAFETY AND ECONOMY FEATURES — *in addition, of course, to the basic ICC requirements.*



ICC Requires that . . .	MIDLAND Gives You These *PLUS* Features . . .	
Tractors must be equipped with two means of activating the emergency feature of the trailer brakes.	● **MIDLAND DASH CONTROL VALVE** applies and releases trailer brakes as fast as service brake. ● **MIDLAND DASH CONTROL VALVE** is pull-type to eliminate accidental application.	● **MIDLAND DASH CONTROL VALVE** provides visual indication whether or not trailer system is charged. ● **MIDLAND DASH CONTROL VALVE** provides automatic application below low pressure warning point so that vehicle can clear traffic lanes.
Tractor brake system must be protected against air loss in the event of trailer breakaway or leakage in trailer system.	● **MIDLAND TRACTOR PROTECTION VALVE** can be installed on your present shut-off cock brackets.	● **MIDLAND TRACTOR PROTECTION VALVE** works with all types of emergency relay valves.
	● **MIDLAND TRACTOR PROTECTION VALVE** has rugged mounting for protection on breakaway.	
All new trailers must have a "no-bleed-back" emergency relay valve to prevent back flow of air from reservoir through supply line.	● **MIDLAND EMERGENCY RELAY VALVE** is large capacity for fast application and release. ● **MIDLAND EMERGENCY RELAY VALVE** eliminates danger of vehicle drive-away without sufficient air in system.	● **MIDLAND EMERGENCY RELAY VALVE** is easily serviceable without removal from vehicle. ● **MIDLAND EMERGENCY RELAY VALVE** gradually applies the trailer brakes in the event of loss of air below 45 psi.



MIDLAND STEEL PRODUCTS CO

Ask your nearest Midland Distributor for complete information on equipping your tractor-trailers to comply with the latest ICC braking regulations. He'll welcome a chance to serve you.

THE MIDLAND STEEL PRODUCTS COMPANY

OWOSSO DIVISION ● OWOSSO, MICHIGAN

Export Department: **38 Pearl Street, New York, N.Y.**

New Members Qualified

Continued

Bandli (M), Robert C. Bazzell (J), Thomas Kenning Brichford (J), C. Kingsley Brown (J), Fred Brown (M), William G. Cichowski (J), James W. Craig (J), Joseph A. Dankovich (J), Anthony F. Dubeck (M), Fred H. Edgar (A), Rudolph Eskra (M), Charles I. Foss (M), Samuel Frank (M), Richard E. Goodwillie (J), Julian M. Greenebaum (J), Dale A. Guoin (M), Harry D. Hall (M), Emil G. Holmberg (M), James Henry Hough (M), Ismail H. Hoyi (J), Carl Peter Kalocsay (M), Joseph M. Madonio (J), Richard W. Malcolmson (M), Louis Mallouf (A), Charles S. McIntyre, III (A), Charles W. Meyka (J), Ray E. Mick (J), John Riordan Neff (J), Robert D. Negstad (J), Robert J. O'Grody (M), William Keith Ojala (J), Robert Ray Parks (J), Daniel H. Pierce (M), Andrew Donald Postma (A), Charles Rose (M), Paul R. Schoenhals (M), Roy T. Stake (J), Lee E. Sutton, III (J), Robert Leo Ullrich (J), Donald A. Wahrman (J), Donald D. Walker (J), Mansel O. Wiley (A), Guy C. Wright, Jr. (J), Henry Tatching Yu (J), J. R. Zanetti (M).

Hawaii Section:

James C. Cushnie (A), John A. Vidal (M).

Indiana Section:

Paul R. Disser (A), Jules B. Maassen (M).

Kansas City Section:

Marvin W. Criqui (A), Fred S. Helling (J), Wilfred Regenbogen (M), Kenneth B. Tilbrook (M).

Metropolitan Section:

Dr. Max Bentele (M), Jonathan E. Boretz (M), George T. Coker, Jr. (J), J. Dillard Collins (M), Victor deCsipkes (M), A. Norton Drake (M), Adam Drenkard, Jr. (M), Hubert Carl Edfors (J), Jacques M. Elsner (M), Ambrose J. Florio (M), Wm. J. Furlick (M), David M. Gaskill (A), Karl G. Granlund (M), Herman H. Hanink (M), Arnold Jacob (J), George W. Kallmeyer (J), James M. Kinsler (M), Thomas Mallis (J), William W. Mapes (M), Oscar O. Miller (M), Harvey Murray Scherr (J), Martin Solon (J), William Spontak (J), Edward Szczech (J), Ralph William Timmerman (J), James B. Treacy (M), Leo W. Weiss (M).

Mid-Michigan Section:

John Hamilton Dodge (J), E. A. Leavengood (M), Harold P. McAlindon (M), George B. Whitesell (A).

Milwaukee Section:

John W. Armstrong (M), E. J. Biever (M), Richard William Chamberlain (M), Donald E. Chaulk (M), Rex L. Curry (A), Jerry Fairley (J), Clifford Henry Lorenz (J), Edward C. Seils, Jr. (M), Frank A. Werner (J).

Mohawk-Hudson Section:

Thomas J. Bradley (M), J. L. Flacke (M), Warren J. Walton (A), John Edward Zweig (J).

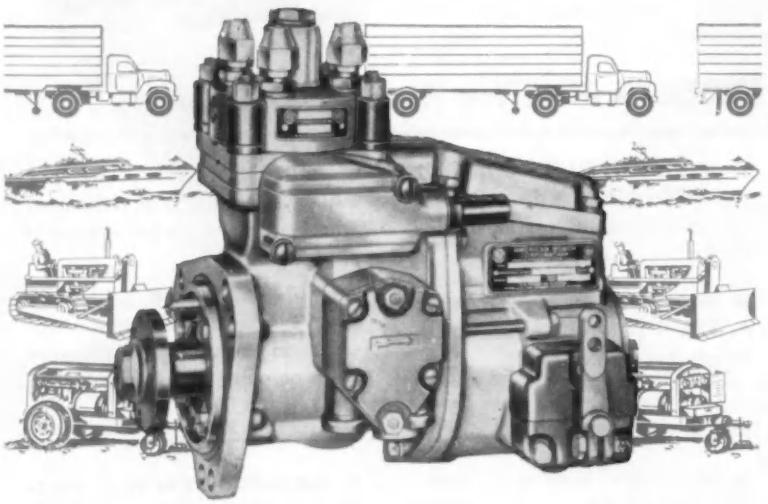
Montreal Section:

Reginald William Beech (A), Andrew Novakoff (J), Jacques Perreault (J), Maurice Poupard (J), Richard Spoonamore (J), Roy Ward (A).

New England Section:

Allen Howard Bolinder (A), Carl Dennis (A), Robert E. Shaw (M).

Continued on page 121



Key to top performance . . .
the PSB fuel injection pump

The PSB Fuel Injection Pump has established an unmatched record for dependable and economical diesel engine performance.

Proven design—here's a fuel injection pump with fewer parts and simple construction, employing positive governor control and a replaceable hydraulic head for fast field servicing.

Outstanding operating economy—from precise fuel metering and accurate distribution . . . the PSB Fuel Injection Pump's efficient design and careful manufacture assure long, trouble-free operation with minimum maintenance.

Backed by low-cost repair service—from "original-maker" repair by factory-trained experts at Authorized American Bosch Service Stations . . . nearly 200 in North America, Hawaii, and Puerto Rico . . . all equipped with special tools and test equipment, and stocked with genuine American Bosch replacement parts.

AMERICAN BOSCH
DIVISION
AMERICAN BOSCH ARMA
CORPORATION
SPRINGFIELD 7, MASS.

5277

XXIV

This is the twenty-fourth of a series of advertisements dealing with basic facts about alloy steels. Though much of the information is elementary, we believe it will be of interest to many in this field, including men of broad experience who may find it useful to review fundamentals from time to time.

Quenching and Tempering Alloy Steels

Of the various methods of heat-treating alloy steels, the most important is that involving quench and temper. This method, which enhances the mechanical properties of the end product, differs materially from normalizing and annealing (previously discussed in this series).

The purpose of quenching is to effect a cooling rate sufficient to develop the desired hardness and structure.

Before quenching takes place, steel is heated to a point above the transformation range. Quenching is the subsequent immersion of this heated steel in a circulated or agitated bath of oil, water, brine, or caustic; or, in the case of austempering or martempering, generally in agitated molten salt baths. Austempering and martempering are preferable where a minimum of distortion is desired.

Quenching *increases* the tensile strength, yield point, and hardness of alloy steels. It *decreases* ductility —that is, elongation and reduction of area. It also decreases resistance to impact. However, by means of tempering, it is possible to restore some of the ductility and impact-resistance—but only at a sacrifice of tensile strength, yield point, and hardness.

The results of mild oil- or water-quenching as related to mass effect can be found in the end-quench hardenability test. Voluminous data concerning this test are issued by AISI and SAE in the form of hardenability bands for the various grades of alloy steels.

If thermal cracking is to be avoided, cooling by liquid quenching should not be carried to a point below 150 deg F. When a temperature of 150 deg F is approached, immediate tempering should follow. Because of residual stresses, no steel should be used in the as-quenched condition.

Tempering can be defined as reheating to a specified temperature below the lower critical range, followed by air cooling. It can be done in furnaces, oil, or salt baths, the temperatures varying from 300 to 1200 deg F. With most grades of alloy steel, it is best to avoid temperatures between 500 and 700 deg because of the "blue brittleness" that occurs in this range. Maximum hardness and wear-resistance result from tempering at low temperatures; maximum toughness is achieved by tempering at the higher levels. Of course, one of the essential reasons for tempering is to relieve the residual stresses set up in quenching.

Bethlehem metallurgists have devoted years of study to quenching, tempering, and other phases of heat-treating. By all means call them if they can be of service to you. And please remember, when you are next in the market for alloy steels, that Bethlehem makes all AISI standard grades, as well as special-analysis steels and the full range of carbon grades.

If you would like reprints of this series of advertisements from No. I through No. XX, please write to us, addressing your request to Publications Department, Bethlehem Steel Company, Bethlehem, Pa. The first 20 subjects in the series are now available in a handy 36-page booklet, and we shall be glad to send you a free copy.

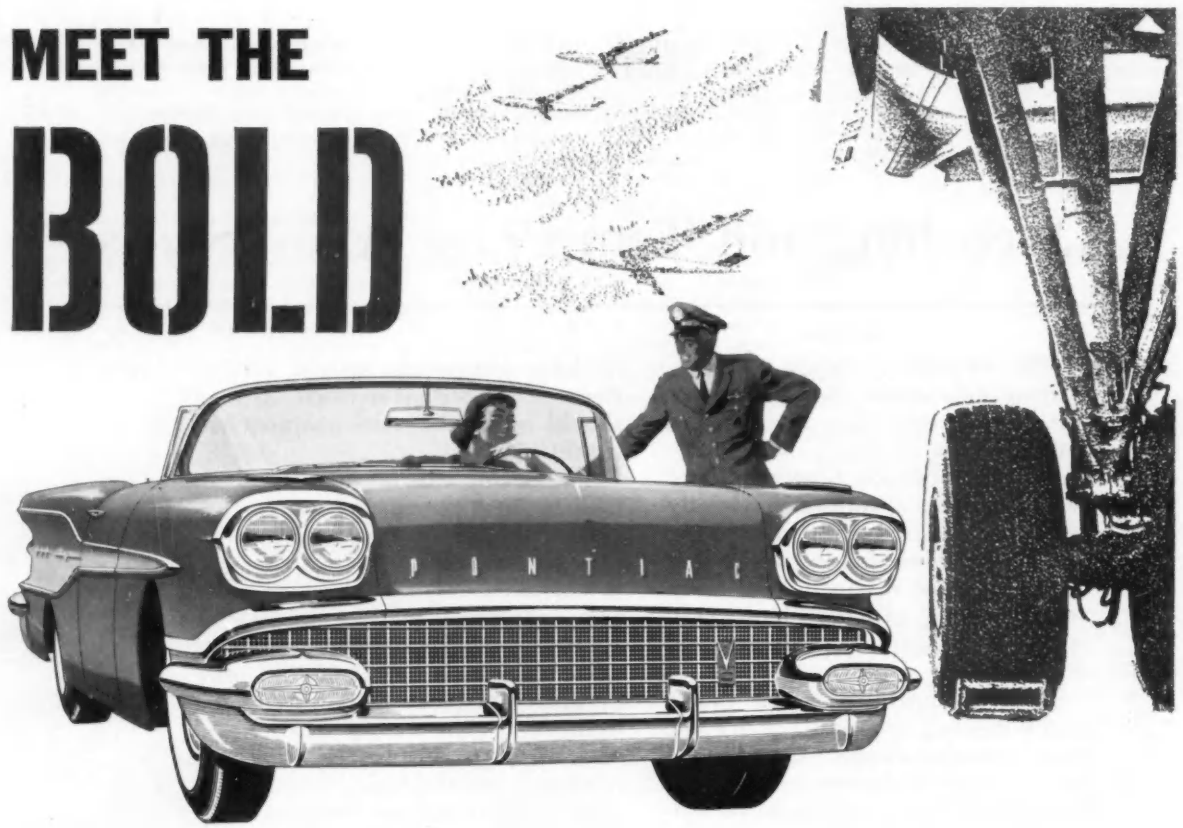
BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation



BETHLEHEM STEEL

MEET THE BOLD



NEW PONTIAC

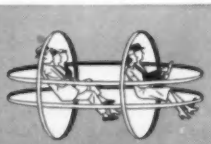
If you like to be first with the newest . . . *this is for you!*

ONLY CAR WITH . . .



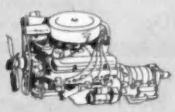
QUADRA-POISE ROADABILITY

made possible by revolutionary new frame design and suspension geometry, virtually eliminates dive, sway and bounce. Only the wheels know where the bumps are and handling's the easiest you've ever known!



CIRCLES-OF-STEEL SAFETY

Pontiac's new body surrounds you with girder steel above, below, front and rear—and floats you on rubber with no metal-to-metal contact. (Same construction in the convertible except for top.)



TEMPEST 335 PERFORMANCE

Scores of exclusive engineering innovations make Pontiac's hefty power plant a miracle of smoothness. Try its jeweled-action response in a choice of six horsepower ratings.

Never before have all these advances been teamed in any car you could own or drive! They have been brought together now in the '58 Pontiac especially to celebrate the Golden Anniversary of Pontiac and General Motors. You'll discover daring—*and wonderful*—new improvements in performance, handling, safety and comfort. And there's a long list of world-of-tomorrow options to choose from—so that you can tailor this Bold New Pontiac to your own personal specifications of the "ideal car". It's all ready for you now at your Pontiac dealer's. So, pay him a visit and make a clean break with the past.

PONTIAC MOTOR DIVISION OF GENERAL MOTORS CORPORATION

New Members Qualified

Continued

Northern California Section:

Robert E. Dilling (A), Arnold R. Doepel (J), John T. Herbert (J), Vasalie L. Peickii (M).

Northwest Section:

Allen Russell Ohlinger (J).

Philadelphia Section:

Philip I. Berman (A), Henry Harris Goodman, Jr. (M), Robert G. Haskell (J), Otto W. Luek (M), Harold Oslick (J), Arnold O. Pukkila (M), Norman J. Schwartz (M).

Pittsburgh Section:

William J. Scovron (M).

St. Louis Section:

Edgar Frederick Fiedler (J).

San Diego Section:

Pedro Jose Alberto Aperlo (J), Robert Raymond Carpignano (J), Barry Lee Farrar (M), John Dillon Fink (J), Jerry D. Hinton (J), Rodney B. Hutchinson (J), Lt. jg Jack Allen Perkins (J).

Southern California Section:

Minoru Sam Araki (J), Bernard George Benaway (M), Richard E. Born (M), Charles Kenneth Brust, Jr. (M), Clifford D. Cannon (M), Robert F. Connelly (M), Chester B. Davis (J), C. Forbes Dewey, Jr. (J), Harold S. Doelcher (A), Maurice P. Donnelly (M), Courtland B. Frain (M), Sanford Joel Friedberg (J), Ronald F. George (M), Joseph Jay Hansen (J), Capt George E. Johnsen (A), Carlton J. King (A), Seymour Lauretz (J), Martin L. Lerner (J), Robert F. Palmini (A), William M. Steed (M), Glenn E. Struble (J), William Prichard Taylor (M), Donald Jack Warren (J), George A. Whaley, Jr. (J).

Southern New England Section:

Collis Herman Beck (J), Robert Leonard O'Brien (J), Ronald B. West (J), Neldon V. Whitty (J).

Syracuse Section

Clifford Thomas Clark (M), Edward A. Kaegi (M), John V. Moynes (M), F. A. Root (M).

Texas Section:

Vernon N. Ferguson (M), Edwin M.

Continued on page 122



"NIX!

We've tried that contact material before!"

common error in CONTACT SELECTION



Frequently, in recommending contacts, Stackpole meets the objection: "We've tried that grade before. It's no good for our equipment!"

Experience proves that such conclusions should not be reached too quickly. Certainly they should not be based on tests of only one or two contact grades.

For instance, an electrical equipment manufacturer rejected a silver-tungsten grade (made by another contact producer) because of its high contact resistance. Because of this, he ruled silver-tungsten contacts "out" of further consideration.

After considerable persuasion, a Stackpole silver-tungsten grade was finally tested and proved eminently satisfactory. *This grade, however, contained different proportions of silver and tungsten powders. Moreover, it was processed by much different methods.*

Other instances might be cited wherein prejudices against silver-graphite, silver-copper and other so-called "standard" materials were overcome by Stackpole Custom-Tailored contact grades.

Actually, Stackpole's chief contact facility is its proved ability to adapt standard materials to specific equipment. A relatively small percentage change in the metal powders used in a mix plus Stackpole's unique processing methods may make a vital difference in contact performance.

The moral then is simply this: If use of a certain contact material grade is indicated by reasons of economy, potentially desirable characteristics, ease of assembly or whatnot, the failure of one such grade only points up the need for further custom engineering.

And such failures usually provide the clues to Stackpole contact engineers as to what changes need to be made!

Stackpole welcomes the opportunity to supply convincing proof of this to quantity contact users.

STACKPOLE CARBON CO., *St. Marys, Pa.*



STACKPOLE

Custom-Engineered CONTACTS

Hundreds of grades in SILVER-GRAPHITE • SILVER-LEAD OXIDE • SILVER-NICKEL • SILVER-MOLYBDENUM • SILVER-TUNGSTEN • COPPER-GRAPHITE GOLD-GRAPHITE • SILVER-COPPER-GRAPHITE • SILVER-IRON OXIDE . . . and other special material combinations mixed to exacting specifications and processed from powders.

New Members Qualified

Continued

Jacobs (A), William Raymond Janowski (J).

Twin City Section:

Olaf T. Aho (M), Frederick A. Caswell (J), Delton G. Crosier (J), Richard C. St. John (J), Edward John Santori (J), Robert W. Thornburg (M).

Wichita Section:

Mrs Olive Ann Beech (M), Curtis Perry Norvell (A).

Williamsport Section:

Charles H. Coder, Jr. (M).

Outside Section Territory:

Walter H. Jogwick (J), Henry O. Kirkpatrick (A), Paul Edward Quinn (M), Stuart L. Rutz (J), Capt. Roy A. Shannon (A), Raymond Milton Zoch (J).

Foreign:

George A. Bronder (M), Western Australia; Alec Ennever William Hibbitt (M), England; Cyril F. Holloway (M), England; Guillermo A. Quant (J), Nicaragua; Luis Carlos Araujo Morais Rego (J), Brazil; Major Graeme Reid (M), England.

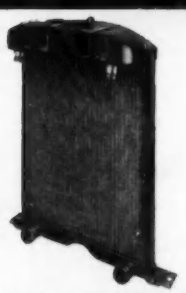
Depend on EUREKA RADIATORS for RUGGED ENDURANCE & MAXIMUM COOLING



OVER 30 YEARS OF SPECIALIZATION

For over 30 years, EUREKA Cores and Radiators have served the automotive industry with utmost dependability. Our facilities, equipment, and personnel are available for your needs. We welcome the opportunity of integrating our specialized skills with your needs to help you achieve a well-planned production schedule.

What are your requirements? We can build Radiators to your order in any type, to any size or shape. Send us your blueprints for prompt quotations!



EUREKA RADIATORS AND CORES
for CARS, TRUCKS, TRACTORS and SPECIAL APPLICATIONS.

AUTO RADIATOR Manufacturing Co.
Guaranteed Radiator Cores Since 1915
2901-17 INDIANA AVE. • CHICAGO 16, ILLINOIS

Applications Received

The applications for membership received between October 10, 1957 and November 10, 1957 are listed below.

Atlanta Section:

Harvey C. Christen.

Alberta Group:

Thomas Starr Icke, Elmer Seidel.

Baltimore Section:

Walter M. Iwanowski, Charles B. Voitelle.

British Columbia Section:

Victor C. Nelson, John Moore Graham Ross.

Buffalo Section:

Warren F. Williams.

Canadian Section:

Peter J. McGale, John F. Quatsch, Earl J. Servos.

Central Illinois Section:

Charles E. Adams, David A. Bullock, Warren W. Davis. Rollen G. Easter, R. D. Evans, James H. Heifner, Bernardo Raul Heker, Albert N. M. I. Lees, Robert Charles Louie, Howard Arthur Marsden, Joseph Louis Oberle, James W. Schulze, Jr., Roger Erwin Treick, James Woodbury Tripp.

Chicago Section:

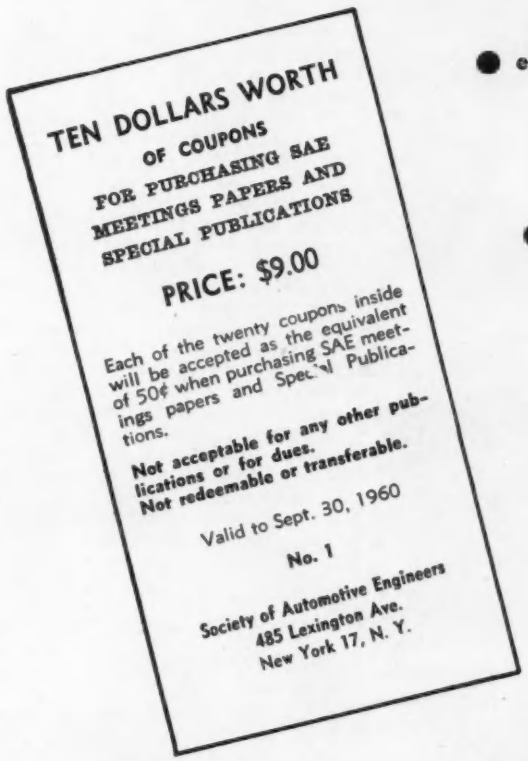
John W. Braze, Clarence H. Coons.

Cleveland Section:

Jack C. Allen, Paul C. Augustine, Jr., Frederic W. Black, Keith A. Carlson, Harry Clary, Sherman S. Cross, Mat-

Continued on page 124

Coupons for convenience



- **each coupon book buys $10.00 worth of SAE meetings papers and Special Publications; it costs $9.00. Each coupon is worth 50¢.**
- **each book is good for a minimum of two years.**
- **coupons will be accepted at National Meetings or with mail orders for SAE meetings papers and Special Publications.**
- **coupon books save you time and trouble.**

ORDER BLANK

(It is requested that cash or check accompany your order for coupon books)
Add 3% city sales tax for deliveries in N. Y. C.

SPECIAL PUBLICATIONS DEPARTMENT
Society of Automotive Engineers
485 Lexington Ave.
New York, N. Y.

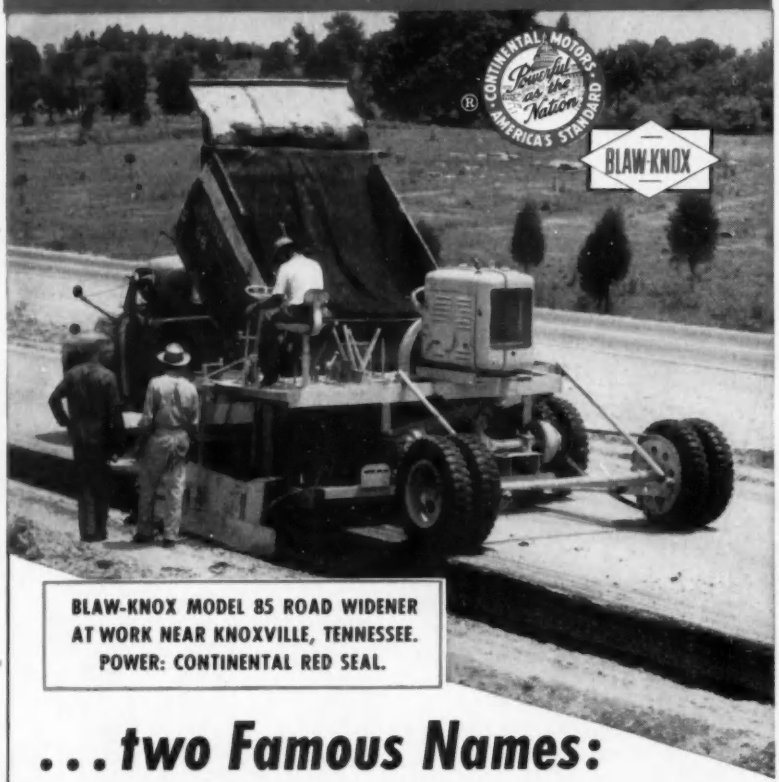
Please send me ..... SAE coupon books at $9.00 each. (Check (cash) for ..... is enclosed.

(Name) _____

(Company Name) _____

(Company address) _____

Teamed for DEPENDABILITY



BLAW-KNOX MODEL 85 ROAD WIDENER AT WORK NEAR KNOXVILLE, TENNESSEE. POWER: CONTINENTAL RED SEAL.

. . . two Famous Names: Continental and Blaw-Knox

Like so many other leading builders of construction machinery, Blaw-Knox offers its customers the tangible PLUS-value of Continental power. Continental engineers each power plant to the specialized requirements of its job, for highest dependability, longest trouble-free life.

•

WORLD'S LEADING INDEPENDENT MANUFACTURER OF INTERNAL COMBUSTION ENGINES, CONTINENTAL MOTORS OPERATES PLANTS IN ATLANTA, DALLAS, DETROIT, MILWAUKEE, MUSKEGON, AND TOLEDO, AND IN ST. THOMAS, ONT., PRODUCING AIR-COOLED AND LIQUID-COOLED ENGINES FOR USE ON LAND, AT SEA AND IN THE AIR.

Continental Motors Corporation

MUSKEGON • MICHIGAN

FACTORY-AUTHORIZED SERVICE AND GENUINE RED SEAL PARTS ARE AVAILABLE EVERYWHERE

Applications Received

Continued

thew J. Fleming, Jr., Ray Gurnick, Raymond H. Klein, Jack J. Kroecker, James E. McClintock, Jr., Merle Messer Morrow, James Aldon Parks, Guy Douglas Payne, Jr., J. A. Smith.

Dayton Section:

Milton E. Feldstein, William J. Steinbruner, Joseph R. Stormer.

Detroit Section:

Howard F. Andrews, Titus Andrisan, Ralph W. Behler, Richard John Boike, James Berry Bragaw, Albert W. Brownes, Eugene A. Carpentier, Granville R. Conrad, Raymond A. Dittmer, A. F. Duttweiler, Jr., Fredrick Rupert Glass, Robert J. Hampson, Robert D. Harrison, John Henry Jacobs, John Edwin James, Charles W. Jones, G. Arthur Kuechenmeister, Robert Donald LeWitter, Leo Joseph Linsenmeyer, Germaine C. Lockwood, William C. Long, Donald Alfred MacGregor, William N. Maher, Stanley E. Mallen, Robert A. Maye, Richard E. McMillen, William R. Medley, Frank A. Novak, Charles M. Nusser, Ralph C. Petersen, Hugh Edwin Pritchard, Habibur Rahman, John L. Reilly, William Albert Salisbury, John Warren Sawyers, John Michael Seaton, Wayne C. Shanks, Jr., Walter L. Sherry, Paul L. Silbert, Jack F. Stokan, H. Yasar Tapan, Herbert G. Taracks, Raymond Vigna, Seymour E. Voorhees, David P. Zart.

Hawaii Section:

Edward V. Kawders.

Indiana Section:

Gerard L. Baumes, Dean S. Bunce, Wilbur W. Carlson, James J. Creamer, Ralph William Dugan, Jr., John J. Ingellis, John K. Knighton, Lawrence E. Lund, John L. Young.

Metropolitan Section:

Harold MacKay Cashmore, Leonard Daum, Bruce J. Gordon, Frank J. McGettrick, Mark E. Otterbein, Alan Pinkus, Joseph Rayman, Warren E. Turner, Morris Leon Wade.

Mid-Michigan Section:

James Burns Bay, Mitchell Bereznoff, William C. Eaton, Richard J. Roberts, Donald F. Urban.

Milwaukee Section:

Dobri Christoff, Richard Glasson, Kenneth I. Olson, William H. Wulff.

Continued on page 126

HELIARC Welding
finds satellite jobs are right in its orbit

Welding together sections for an earth satellite, under the most exacting specifications, may not be your particular problem. But if welding light-gage, hard-to-weld metals is slowing up your production—LINDE's HELIARC Inert Gas Shielded Arc Welding, using LINDE Argon as a shielding gas, may be just what you've been looking for.

HELIARC Welding is LINDE's method for high-speed fusion of commercial metals, automatically, or manually in all positions. LINDE Argon, guaranteed 99.99% pure, protects the weld. It is readily available, in cylinders or in bulk, from convenient sources all over the nation.

Get more information about HELIARC Welding and LINDE's other modern welding methods. For a free copy of the booklet, "Modern Methods of Joining Metals," address Dept. SA12, LINDE COMPANY, Division of Union Carbide Corporation, 30 East 42nd Street, New York 17, N. Y. *In Canada:* Linde Company, Division of Union Carbide Canada Limited.



FOR THE BEST IN ELECTRIC WELDING—LOOK TO LINDE!

Shells of the Earth Satellite, Project Vanguard, are made of .050-in. magnesium alloy sheet, containing small amounts of aluminum and zinc. The two hemispheres are manually welded together (above), with a cover ring, by HELIARC Welding, a LINDE development utilizing an argon-shielded tungsten arc. Brooks & Perkins, Inc., are the fabricators.



Linde TRADE-MARK

UNION CARBIDE

The terms "Linde," "Heliarc" and "Union Carbide" are registered trade-marks of Union Carbide Corporation.

Applications Received

Continued

Montreal Section:

John Alfred Reader.

New England Section:

Donald C. Alexander, C. Perry Giddings, Eugene D. Veilleux.

Northern California Section:

Thomas J. Dahm, Frank J. Davis, Finn S. Reinath.

Northwest Section:

Robert Lee Larabee.

Oregon Section:

Riley Owen Montgomery, E. A. Paulson, J. Porter Reed.

Philadelphia Section:

Edward F. Fricker, Jr., Paul Louis Gerard, Richard M. Lawrence, William E. McCafferty, J. Carl Moore, John H. Willard.

Pittsburgh Section:

Joseph F. Rudzki, Jr.

St. Louis Section:

Oliver B. Cruse.

San Diego Section:

Loren D. Hamlin, Stanley P. Merritt, Robert S. Myers, Rollin K. Norris, John E. Stoddard.

Southern California Section:

James M. Bruce, Vincent N. Capasso, Jr., Richard H. Dougherty, Allan B. Fredhold, Jr., Harold T. Glenn, Sal J. Grassadonia, Patton Lewis, J. A. Lockheed, Anthony M. Marzolla, Howard W. McFarland, Pat Edward Placey, William W. Saxton, Fred E. Schultz, Frank L. Spencer, M. H. Sperling, A. S. Turner, Ben Gee-Bun Wong.

Southern New England Section:

Edward Payson Bullard, III, Robert O. Cooling, John A. Lozzi, Howard B. Marx, Elliott L. LaMontagne, Richard W. Wilby.

Spokane-Intermountain Section:

Henry N. Ard, George S. Headstrom, Lloyd G. Massender, Kenneth E. Nicholson, Robert Paul Schwartz.

Syracuse Section:

Stephen G. Woodward.

Texas Section:

James Martin McDonald, Jr.,

Texas Gulf Coast Section:

William C. Keefe.

Western Michigan Section:

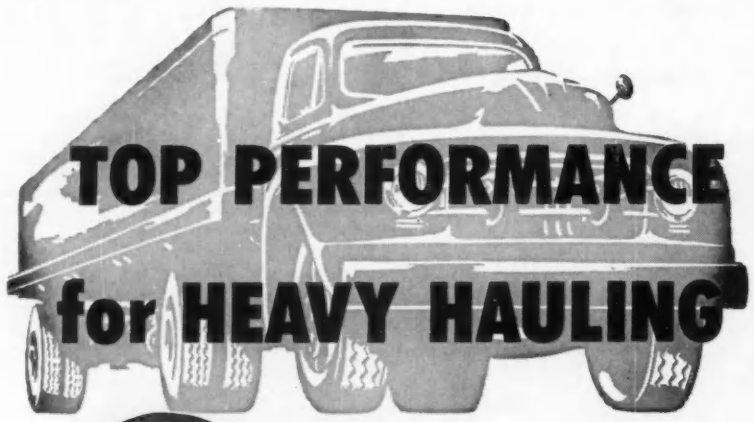
James Ronald Doe, John O. Lundwall, John T. Mehne, John H. Sikkenga.

Outside of Section Territory:

William A. Graf, Turner L. Miller, Richard Allen Partin, Michael J. Phillips, Arnold B. Skromme.

Foreign:

Rafael Arco Hernandez, Cuba; Edgar Knoop, Germany; Julius Kong, Brazil; James E. Lyle, Mexico; Donald H. McGown, Netherlands; James Harvey Nelson, England; K. G. Pillay, India; V. N. Suryanarayanan, India; Dr. Bernard Frederick Willetts, England.





BORG AND BECK

TYPE "E" CLUTCH

- *Husky—Heavy Duty*
- *"Strap Drive"*
- *Friction-Free*
- *Smooth Engagement*
- *Minimum Maintenance*

Engineered by BORG & BECK

for that vital spot where power takes hold of the load

BORG & BECK B-W BORG-WARNER

BORG & BECK DIVISION

BORG-WARNER CORPORATION • CHICAGO 38, ILLINOIS



How do you build an axle to take punishment like this?

LeTourneau-Westinghouse does it with heat-treated 4340 H nickel steel

LeTourneau - Westinghouse field tested many types of steel for the 3½-in. drive axles on their 30,000-pound Adams "660" motor grader.

They finally settled on AISI 4340 H — a through-hardening, nickel alloy steel, heat treated to a minimum tensile strength of 188,000 psi . . . a yield strength of 150,000 psi . . . Brinell Hardness 375.

With this steel, LeTourneau-Westinghouse engineers get the properties needed in heavy-duty axles for off-highway equipment. Get maximum strength with minimum weight. Get toughness for absorbing shock, impact and overload.

Is the material you're using providing the ruggedness and dependability you need?

Type 4340 H may — or may not be the material to do it for you. But there are a variety of other nickel alloy steels. One may be just what you're looking for.

An Inco booklet "Properties of Heat Treated Wrought Nickel Alloy Steels" gives helpful property charts on oil and water hardening steels and case hardening steels. Write for your copy today.

The International Nickel Company, Inc.
67 Wall Street New York 5, N. Y.



FULL - FLOATING, TWO-PIECE DRIVE AXLE designed by Adams Division of LeTourneau-Westinghouse, Indianapolis, Indiana.

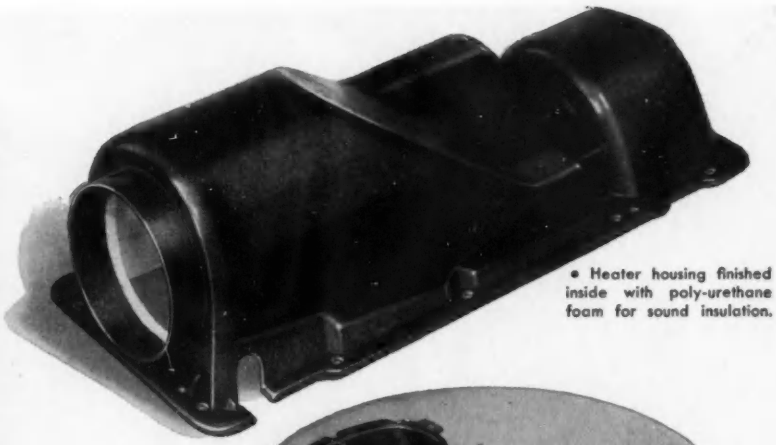
To develop properties listed in text, type 4340 H steel (1.55% to 2.00% Ni.) is oil quenched from 1500°F and drawn for three hours at 860°F.

INCO NICKEL

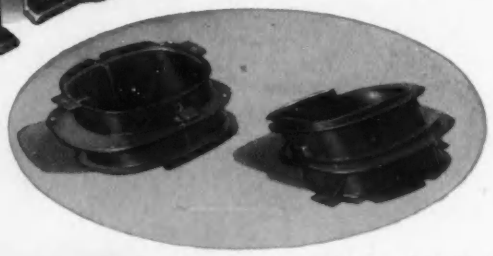
NICKEL ALLOYS PERFORM BETTER LONGER



• Car air conditioning ducts covered with poly-urethane foam for thermal insulation.



• Heater housing finished inside with poly-urethane foam for sound insulation.



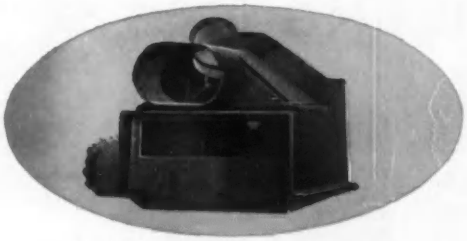
• Reinforced plastic shrouds for car side air duct outlets.

FABRICON

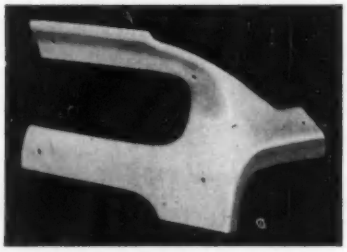
REINFORCED PLASTIC MOLDINGS



• Heater blower housing.



• Housing for air conditioning system.



• Exterior trim molding ready to be finished with a decorative simulated wood grain pattern.

Custom premix compounds plus new improved processing techniques permit economical volume production of intricate, complex parts

Intricate, complex parts are difficult to design and costly to make out of metals. That's why more and more design and production engineers are turning to Fabricon reinforced plastic moldings for the answers to their problems. For component parts like those shown here can be quickly, easily produced with relatively inexpensive tooling . . . formed at once into finished pieces that require no costly secondary operations. What's more, they are made of special custom premix compounds developed by Fabricon after years of working with all types of resins and fiber reinforcements. And they are processed by modern laboratory controlled molding techniques which assure consistent uniformity of quality plus the best possible combination of the physical properties required for each individual application.

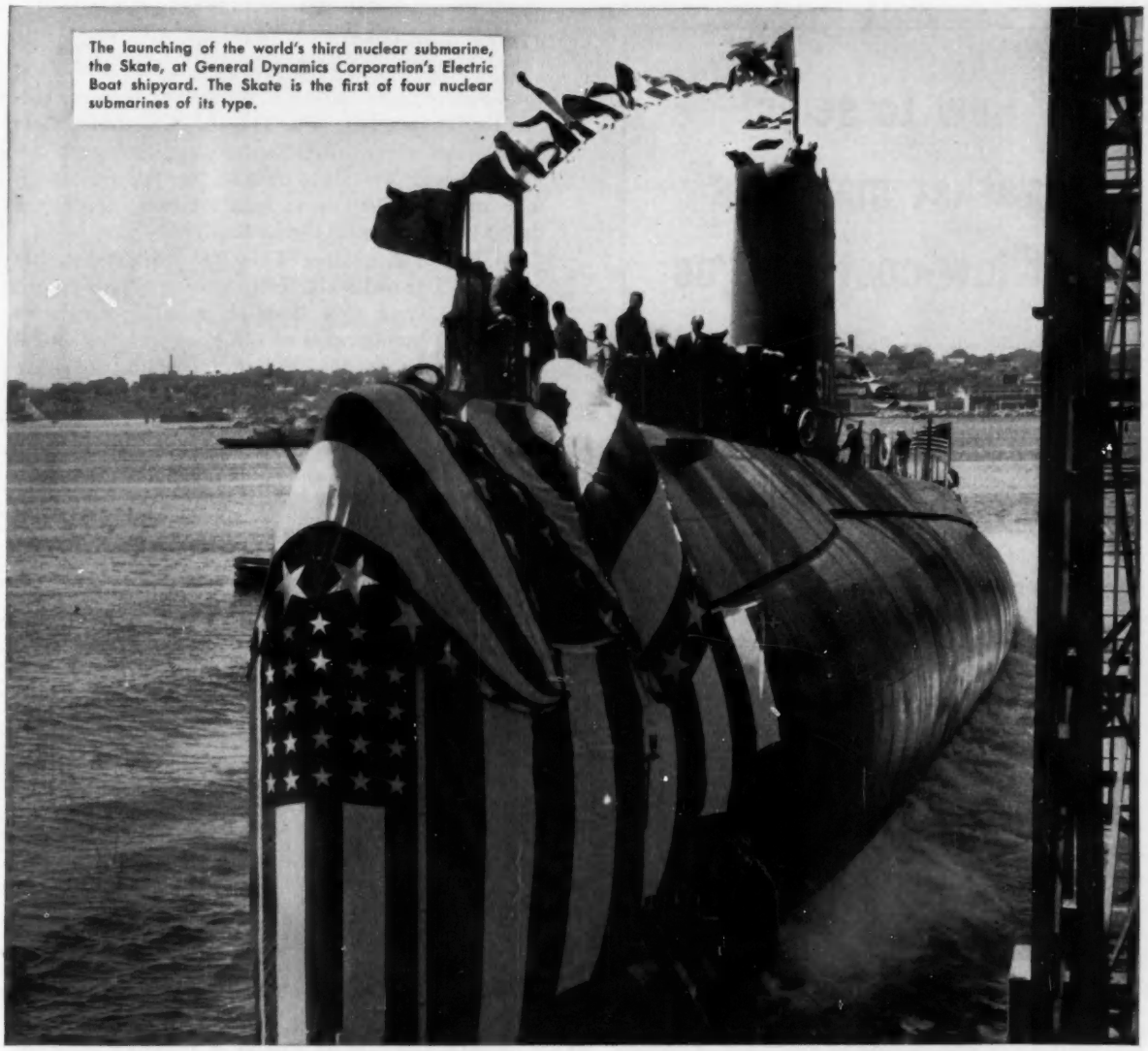
Want detailed information on how Fabricon products, facilities and services can be of help to you? Just outline the nature of your problem for prompt engineering recommendations . . . or send print of part for firm quotation.

FABRICON PRODUCTS

A Division of The EAGLE-PICHER Company

1721 W. Pleasant Street • River Rouge 18, Michigan

Reinforced Plastic Molded Products • Plastic Impregnated and Coated Materials



The launching of the world's third nuclear submarine, the Skate, at General Dynamics Corporation's Electric Boat shipyard. The Skate is the first of four nuclear submarines of its type.

from the SKATE . . .

EXPERIENCE FOR TOMORROW'S AUTOMOTIVE FILTERS

What are the filtration requirements of an atomic submarine? Like any filtration problem, they are a combination of factors, such as: the nature of the fluid to be filtered, operating pressures, temperature, corrosion . . . all of which dictate the filter media and form of the filter. The filters must be engineered to meet the specific requirements of the job. That's why the Electric Boat division of General Dynamics Corporation chose Purolator.

The engineering skills and manufacturing capabilities which make it possible for Purolator to design and build filters for an infinite variety of applications, including nuclear submarines, will produce better automotive filters. In a fast-moving industry, tomorrow's requirements must be anticipated today. Because of its role as designer and builder of filters for all phases of industry, Purolator has, *today*, the experience needed to provide the specific filters you will need for tomorrow's specific requirements.

Your toughest filtration problems are within Purolator's experience.

Filtration For Every Known Fluid

PUROLATOR
PRODUCTS, INC.
RAHWAY, NEW JERSEY AND TORONTO, ONTARIO, CANADA

How to select gasket materials for low-cost flanges

Stamped, rough-finished cast, and other low-cost flanges require a gasket material that will seal irregular surfaces efficiently under the low bolting pressures usually available.

cork-and-rubber compositions

Such sealing jobs can usually be handled with truly compressible materials such as Armstrong cork-and-rubber compositions. These materials combine tiny cork particles in a continuous matrix of synthetic rubber. Varying the proportions of cork and rubber makes it possible to provide the right degree of compressibility for a wide variety of applications.

For extremely light assemblies, several Armstrong sponged cork-and-rubber materials with very high compressibility are available. When compressed to the recommended deflection, these sponged materials are impervious.

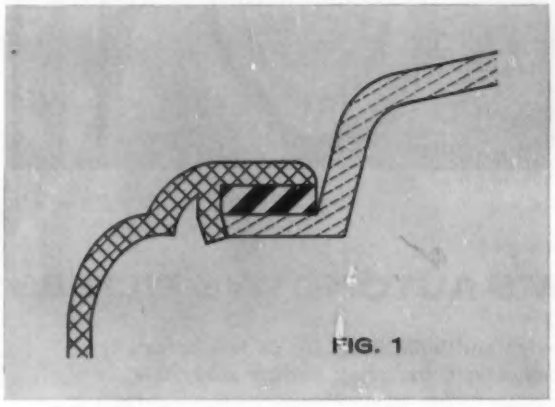


FIG. 1

solvent resistance

Cork-and-rubber materials generally have resistance to contained fluids comparable to that of straight synthetic rubbers of corresponding base polymers. Armstrong cork-and-rubber materials are available with nitrile-, styrene-, and chloroprene-type synthetic rubber binders. Two butyl compositions are also available. This group of synthetic binders makes it possible to seal a wide variety of fluids.

typical applications

A weathertight seal is provided by an Armstrong cork-and-sponged butyl gasket in an automotive taillight assembly, Figure 1. The material conforms to the normal irregularities in the plastic lens and die-cast rim and provides a tight seal in this pre-assembled unit. Excellent ozone-resistance imparted by the butyl binder assures long service life.

In Figure 2, another Armstrong cork-and-rubber compound provides an effective seal for the stamped hand-hole cover on a diesel engine. The softness of the gasket permits economical light-pressure assembly. Frequent opening and closing of the cover are facilitated, because the cork-and-rubber material resists fatigue and retains its sealing efficiency.

In the waterproof electric motor housing in Figure 3, an Armstrong cork-and-rubber composition accommodates surface irregularities in the stamped cover yet stands up under exposure to lubricating oils and sea water.

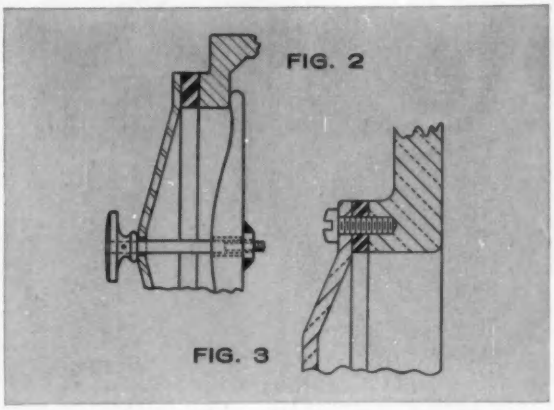


FIG. 2

FIG. 3

Sealing cost-cutting flanges is only one of many sealing jobs Armstrong cork-and-rubber materials can handle efficiently and economically. Your Armstrong representative will be glad to give you information as to how these mat rials might be used in your particular applications.

SEND FOR 1957 EDITION OF "ARMSTRONG GASKET MATERIALS"

This 16-page booklet discusses the choice of proper gasket materials and describes Armstrong cork, cork-and-rubber, synthetic rubber, and fiber sheet materials. Look for this booklet in Sweet's product design file. For a personal copy, write Armstrong Cork Company, Industrial Division, 7112 Durham Street, Lancaster, Penna.



Armstrong

GASKET MATERIALS

. . . used wherever performance counts



Performance features of TORRINGTON CAM FOLLOWERS

Heavy sectioned outer race to absorb high rolling and shock loads.



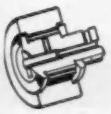
Integral stud for cantilever mounting, case-hardened, with tough core for high strength to withstand shock loads.



Easily relubricated at either end or through cross hole in stud. Ends accommodate standard drive grease fittings or plug seals.



Full complement of small diameter rollers for maximum radial capacity and efficient anti-friction performance.



Races precision ground for even load distribution and uniform low end play.

Built to "FOLLOW THROUGH" under high shock loads

Every feature of the Torrington Cam Follower is designed to insure efficient performance and long service life under heavy rolling and shock loads in cam or track follower service.

Precision made throughout, Torrington Cam Followers are available in sizes from ½" to 2¼" OD. Special surface finishes such as chrome and cadmium plate or oxide black can be provided.

Our engineering staff will be glad to work with you in applying these reliable units to your cam-controlled or track-type equipment. You can depend on Torrington Cam Followers to "follow through" on the job because every element is designed for ultimate capacity. *The Torrington Company,* Torrington, Conn.—and South Bend 21, Ind.

TORRINGTON BEARINGS

District Offices and Distributors in Principal Cities of United States and Canada

NEEDLE • SPHERICAL ROLLER • TAPERED ROLLER • CYLINDRICAL ROLLER • BALL • NEEDLE ROLLERS • THRUST

Pneumatic controls



AiResearch is the largest designer and manufacturer of pneumatic controls for the aircraft and associated industries. During the past 10 years more than 300,000 units have been produced and are in service.

Temperatures of the fluids (including gas and liquids) range from −400°F to +2000°F at pressures to +6000 psig. The units operate at any ambient pressure at ambient temperatures from −300°F to over +1000°F. Line diameters range from ⅛ inch to 15 inches.

This equipment is developed and tested in the finest pneumatic facilities in the world. Your inquiries are invited.

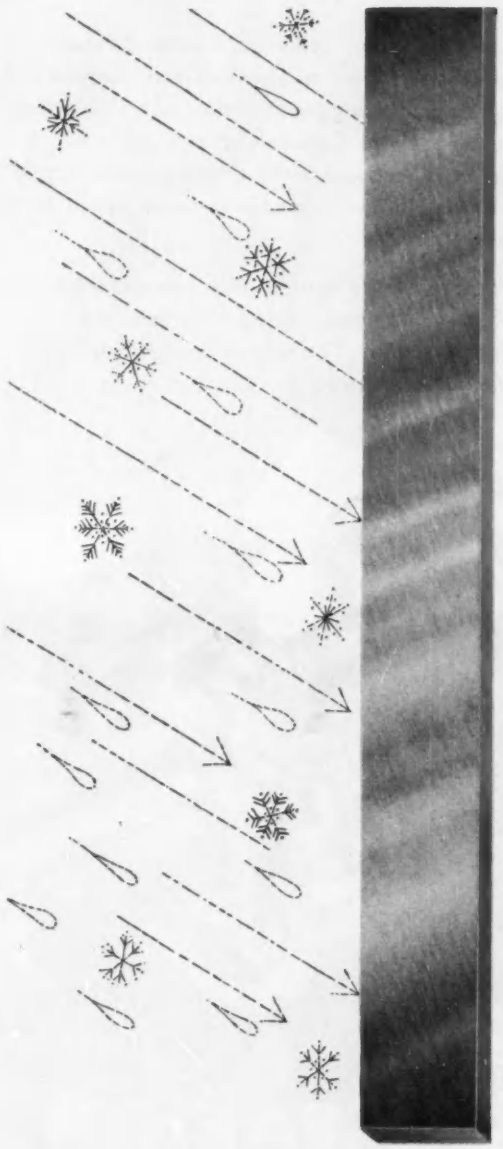
• *Outstanding opportunities for qualified engineers*

THE GARRETT CORPORATION

AiResearch Manufacturing Divisions

Los Angeles 45, California . . . Phoenix, Arizona

Designers and manufacturers of aircraft and missile systems and components: REFRIGERATION SYSTEMS • PNEUMATIC VALVES AND CONTROLS • TEMPERATURE CONTROLS CABIN AIR COMPRESSORS • TURBINE MOTORS • GAS TURBINE ENGINES • CABIN PRESSURE CONTROLS • HEAT TRANSFER EQUIPMENT • ELECTRO-MECHANICAL EQUIPMENT • ELECTRONIC COMPUTERS AND CONTROLS



Don't Forget... Stainless Steel Doesn't Rust*

*Elementary? Yes—but it's an elementary reason why car buyers prefer autos with stainless steel trim and parts! Stainless steel's beauty is more than skin deep... its utility lasts the life of the car, adds *resale* value. Stainless doesn't dent like other metals, resists scratches, road chemicals, comes bright and clean with soap and water. And the *best* stainless steels are made with Vancoram Ferro Alloys. Your supplier can give you more details about the added value you can build into your autos—with *stainless steel!*

VANCORAM

VANADIUM CORPORATION OF AMERICA

420 Lexington Avenue, New York 17, N.Y. • Chicago • Cleveland • Detroit • Pittsburgh

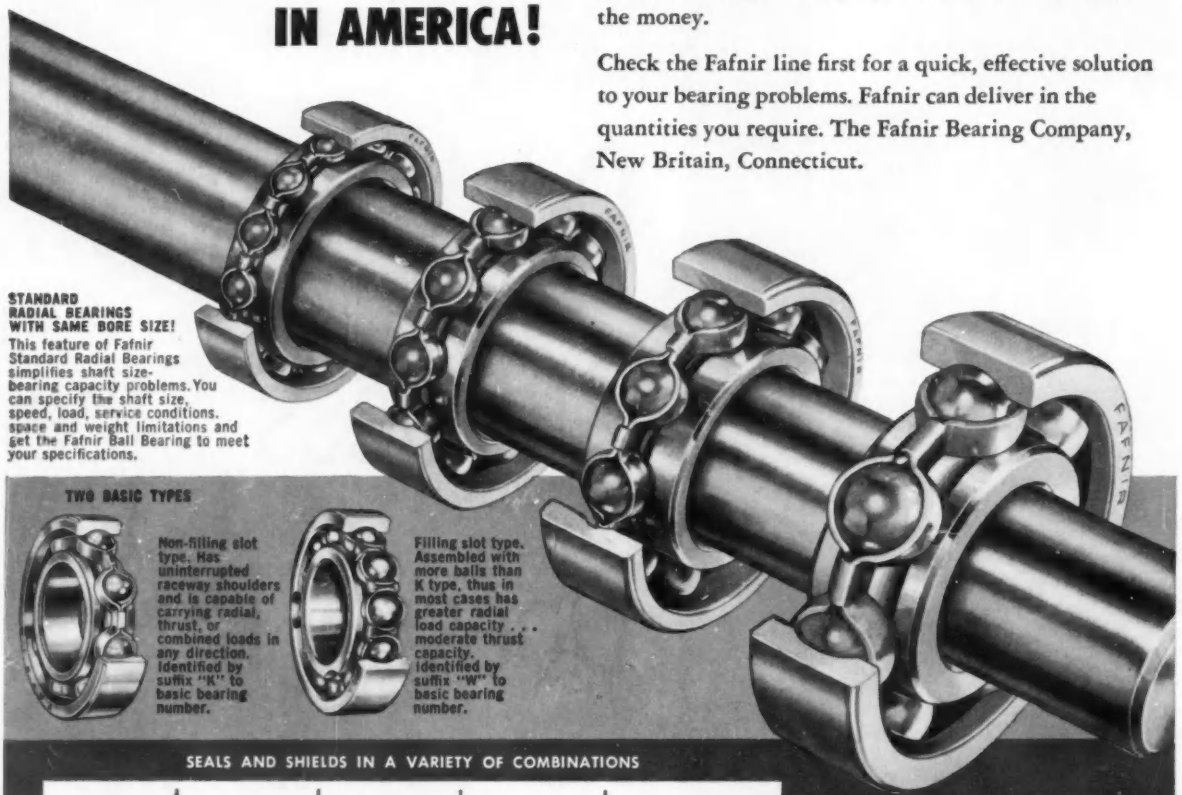
Producers of alloys, metals and chemicals

For the most effective answers to your bearing problems...

FAFNIR OFFERS THE MOST COMPLETE LINE OF BALL BEARINGS IN AMERICA!

Whatever your bearing needs, your best bet is Fafnir. The reason . . . Fafnir makes America's most complete line of ball bearings, ranging from standard radial to custom-made jet engine types. Various tolerances and combinations of seals and shields enable Fafnir to supply the best bearing for the purpose — the *most* bearing for the money.

Check the Fafnir line first for a quick, effective solution to your bearing problems. Fafnir can deliver in the quantities you require. The Fafnir Bearing Company, New Britain, Connecticut.



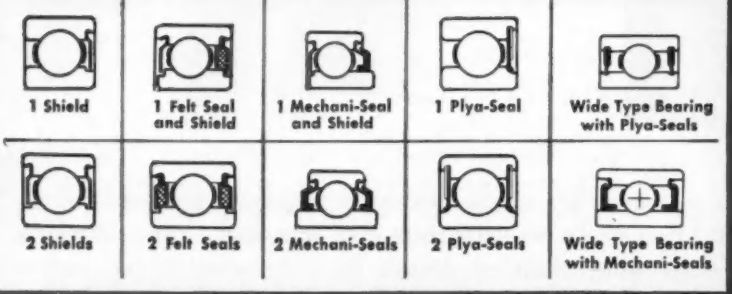
STANDARD RADIAL BEARINGS WITH SAME BORE SIZE!
This feature of Fafnir Standard Radial Bearings simplifies shaft size-bearing capacity problems. You can specify the shaft size, speed, load, service conditions, space and weight limitations and get the Fafnir Ball Bearing to meet your specifications.

TWO BASIC TYPES

Non-filling slot type. Has uninterrupted raceway shoulders and is capable of carrying radial, thrust, or combined loads in any direction. Identified by suffix "K" to basic bearing number.

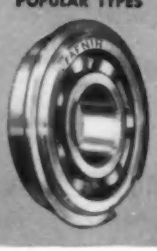
Filling slot type. Assembled with more balls than K type, thus in most cases has greater radial load capacity . . . moderate thrust capacity. Identified by suffix "W" to basic bearing number.

SEALS AND SHIELDS IN A VARIETY OF COMBINATIONS

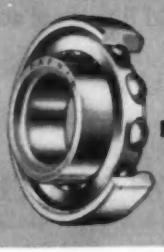


FAFNIR BALL BEARINGS
MOST COMPLETE LINE IN AMERICA

POPULAR TYPES



Wireloc *(Snap ring type)*



Front Wheel



Double Row



BENDIX PRODUCTS DIVISION

For a quarter of a century, Bendix Products Division has maintained leadership in many important automotive components. Today, Bendix* Power Brakes, Power Steering, wheel brakes, constant velocity joints and hydraulic remote controls are still the industry's choice for outstanding performance.

BENDIX-SKINNER DIVISION

With a new and modern plant Bendix-Skinner Division, originator of micronic filtration, has greatly increased its capacity to meet the design needs and production requirements of the automotive industry with over 350 types of filters.

MARSHALL-ECLIPSE DIVISION

One fact tells the whole story of the automotive products of the Marshall-Eclipse Division. Bendix-Eclipse brake linings and blocks are on more new vehicles than any other make of linings and blocks.

LAKESHORE DIVISION

This division manufactures hydraulic valves and cylinders for automotive and agricultural applications—specializing in power steering requirements. Also producer of grey iron castings, both in green sand and shell molding methods.

ECLIPSE MACHINE DIVISION

The Eclipse Machine Division has manufactured well over 115 million Bendix* Starter Drives and also manufactures the famous Stromberg* Carburetor and the Bendix* Electric Fuel Pump.

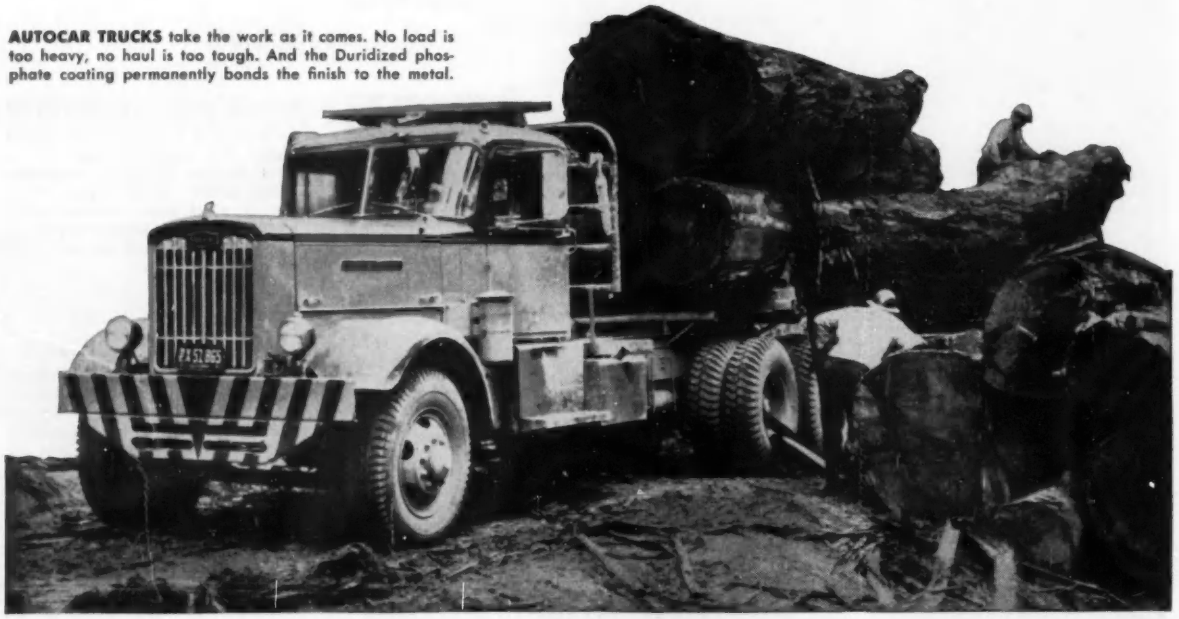
BENDIX RADIO DIVISION

The fact that Bendix* Radio not only is deeply engaged in production of all types of radio equipment, but is equally familiar with automotive problems as well, makes Bendix Radio the ideal choice of manufacturers interested in quality performance at production prices.

*REG. U. S. PAT. OFF.

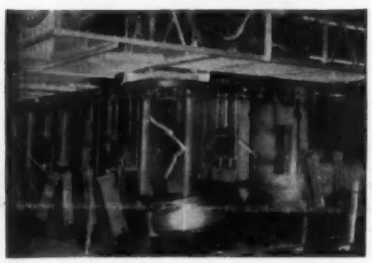
Bendix
AVIATION CORPORATION

AUTOCAR TRUCKS take the work as it comes. No load is too heavy, no haul is too tough. And the Duridized phosphate coating permanently bonds the finish to the metal.

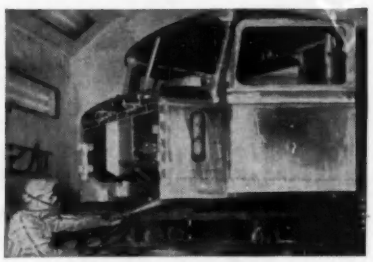


ACP Duridine® PREPAINT CHEMICAL TREATMENT

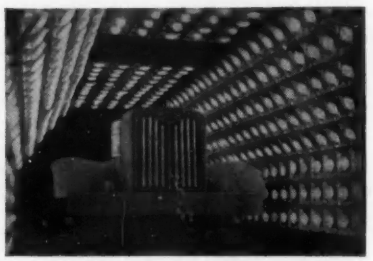
SIMULTANEOUSLY CLEANS AND PHOSPHATE COATS SHEET STEEL USED IN FAMED AUTOCAR TRUCKS



ALL SHEET METAL receives the ACP Duridine treatment. This removes all traces of grime and oil and produces on the metal a thin hard coating of nonmetallic phosphate which forms an excellent bond for the paint finish.



HIGH QUALITY FINISHES on Autocar trucks are assured by the ACP Duridine treatment, plus equipment and materials incorporating the latest technical developments. Skilled personnel add their experience.



HARD, DURABLE FINISHES, bonded with ACP Duridine, protect the metal in Autocar trucks. Uniformly controlled infrared baking of paint is done while the truck moves along the chassis line.

As simple as alkali cleaning, but much more effective, ACP Duridine cleans and phosphate coats steel in a single operation. It carries off harmful surface dirt, oil and grease. It develops a thin, tight, close-grained nonmetallic phosphate coating which inhibits corrosion and forms an excellent bond for the paint finish. It is applied in 1 to 3 minutes in a 4-stage power spray washer.



Learn more about ACP Duridine

Write for Bulletin 1406 today

CHEMICALS ACP PROCESSES

AMERICAN CHEMICAL PAINT COMPANY, Ambler 36, Pa.

DETROIT, MICH. • ST. JOSEPH, MO. • NILES, CALIF. • WINDSOR, ONT.

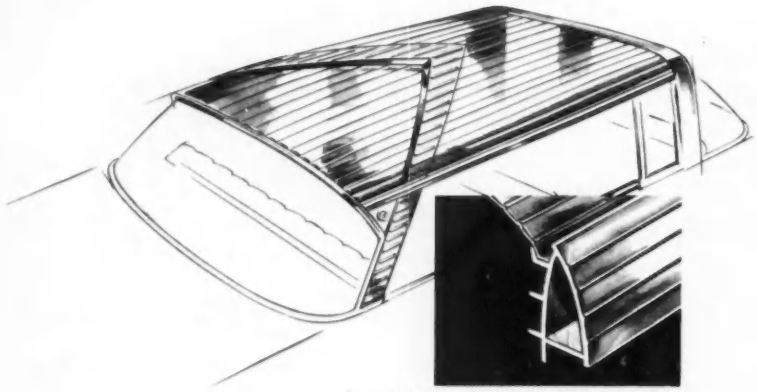
New Chemical Horizons for Industry and Agriculture



increase design versatility,
offer beauty plus economy



The Finest Products
Made with Aluminum
are made with
REYNOLDS ALUMINUM



Extruded side rail with integral drip molding.

LOWER CAR DESIGNS are calling new attention to roof areas—and embossed clear and color anodized aluminum roof panels offer interesting possibilities from both sales and engineering standpoints. Here are some aluminum roof panel advantages to consider:

- Tremendous styling possibilities through integral bright finished emblems, moldings and other decorative effects.
- Design reinforcing latitudes through the use of embossing techniques.
- Reduced tooling costs through integral design.
- Increased design versatility using current fabricating techniques and equipment.
- Eye-catching, colorful beauty with the Reynolds Aluminum "gleam of gold" and "look of sterling" plus the beauty of aluminum's variety of embossed patterns.

Aluminum roof panels are another example of where the forward looking automotive industry is considering increased use of aluminum to cut costs, reduce weight, increase beauty, improve performance and add greater value in fine new cars.

To help you get the very most from the aluminum you use, Reynolds Aluminum Specialists will be glad to work with you on both present and future applications. For details on aluminum mill products and on fabricated aluminum parts and trim, call the Reynolds office listed under "Aluminum" in your classified telephone directory. Or write *Reynolds Metals Company, Fisher Building, Detroit 2, Michigan* or *P.O. Box 1800-MW, Louisville 1, Kentucky.*

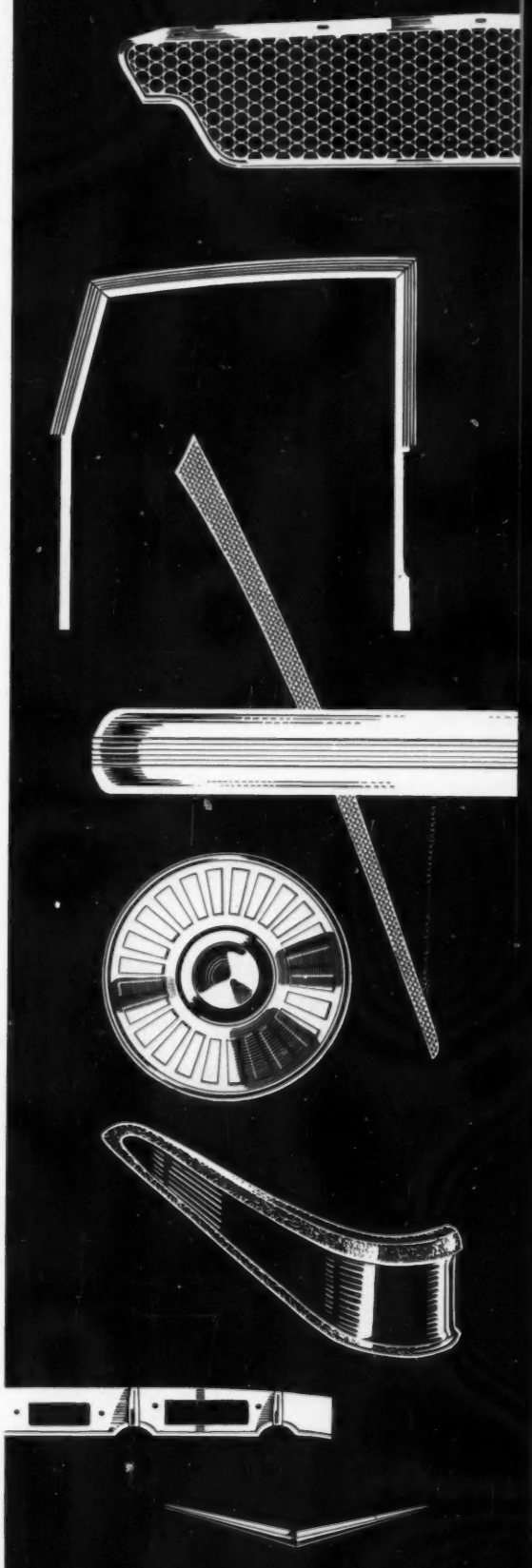
NOTE: Before you buy any part—have it priced in aluminum. Basic material costs do not determine part costs. New techniques and processes—applicable only to aluminum—can give you a better product at a lower *final* cost.

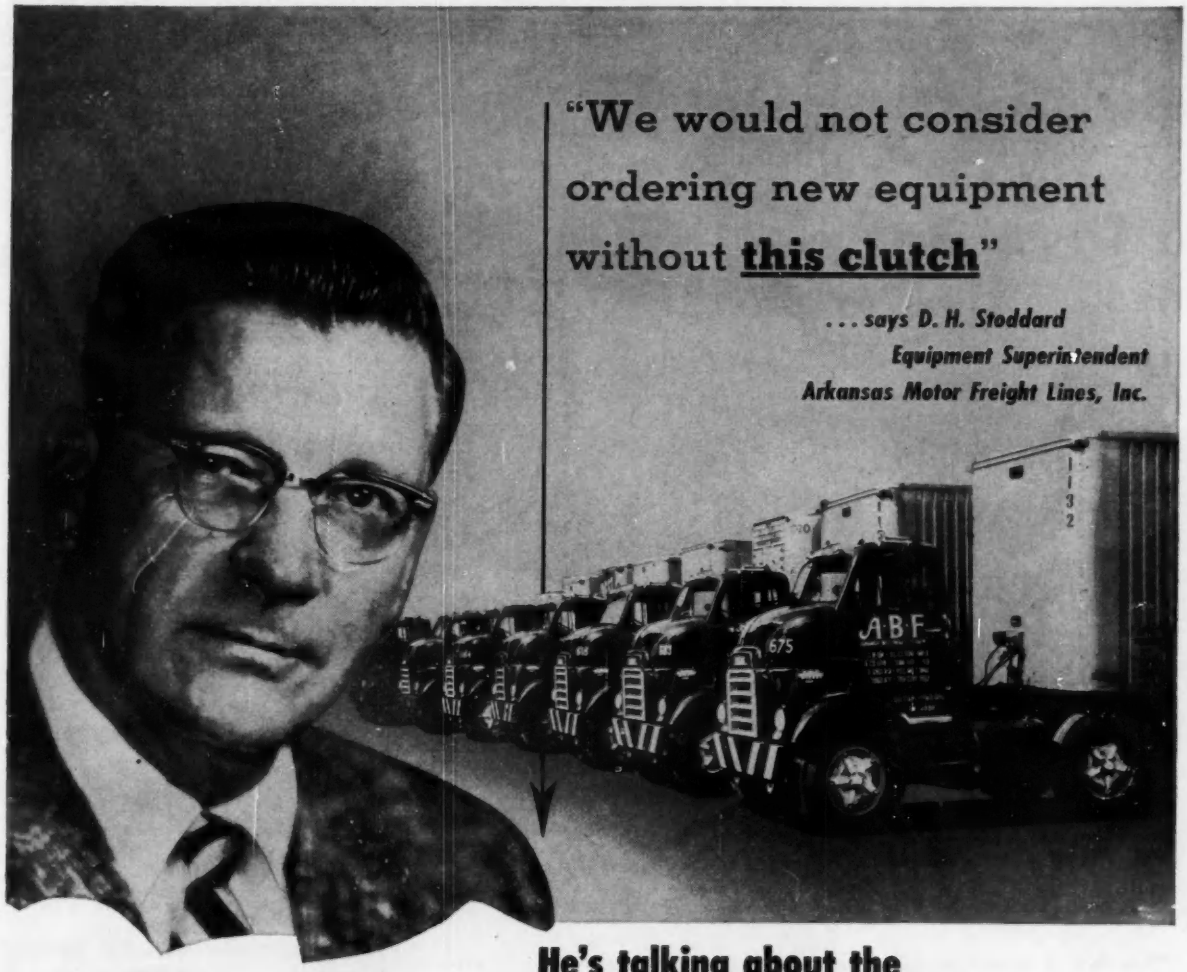
REYNOLDS ALUMINUM

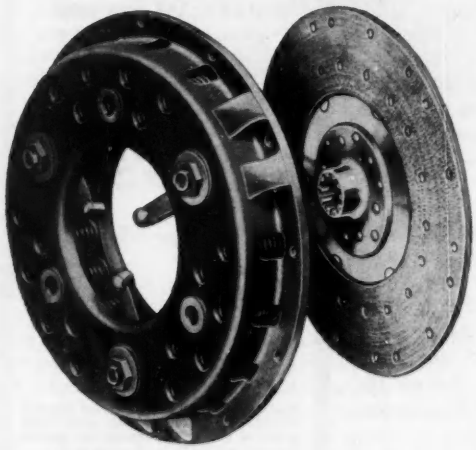
THE METAL FOR AUTOMATION
TRADE MARK

The Finest Products Made with Aluminum are made with REYNOLDS ALUMINUM

Watch Reynolds All-Family Television Program "DISNEYLAND", ABC-TV.







He's talking about the *Lipe* Heavy-Duty Direct Pressure Clutch

"Since July, 1955," says Mr. Stoddard, "we have some 100 more heavy units equipped with the Lipe Direct Pressure Clutches. Some sixty units were so equipped as original specifications, with the remainder being change-overs from other makes and types of clutches.

"We are at present taking delivery of the first of 122 Model DF869 Diesels, all equipped with the DP clutch. From our past experience, we would not consider ordering new equipment without specifying this clutch. We operate some 1,500,000 miles per month, and . . . *we have not had one wear out or burn out.*"

If you would like trouble-free clutch performance like that of Arkansas Motor Freight in your vehicles . . . write today for complete details on the Lipe DP Clutch . . . now available in five sizes for engines developing from 300 to 1300 ft-lb of torque.

LIPE ROLLWAY

Lipe-ROLLWAY CORPORATION
SYRACUSE 1, N. Y.

MANUFACTURERS OF AUTOMOTIVE CLUTCHES & MACHINE TOOLS

Revolutionary *Filtronic*® Carburetor Air Filter

Product of FRAM

Pioneering Research



ONLY FRAM CARBURETOR AIR FILTERS HAVE THIS EXCLUSIVE PATENTED BUILT-IN GASKET!

This fact is important to automotive engineers interested in *protecting* their fine engines from premature wear. It is very easy to develop an air filter that will protect the engine *initially*. But, what happens after the first 10,000 miles?

Only FRAM features the patented built-in gasket shown above. This FRAM patented design absolutely prevents by-passing of dirty air—initially *and throughout* its long life. It eliminates all of the defects found in other types of sealing—such as metal to metal, metal to cork or compound gaskets and metal beads pressed against a flat plastic face. Unless these types of cartridges are replaced after servicing, in *exactly* the same position, they leak dust and dirt.

FRAM engineers designed the exclusive FRAM patented built-in gasket as an integral part of the end seal. It can never leak dirt-laden air—no matter how often it is serviced!

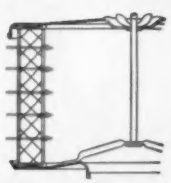
Add these other FRAM advantages: 99.+% efficiency, easy cartridge replacement and you'll know why FRAM *Filtronic* Carburetor Air Filter Cartridges are the finest on the market today; why nearly 50% of 1957 cars are equipped with FRAM—the air filter that obsoletes all other filter types.

FRAM Corp., Providence 16, R. I. • Fram Canada Ltd., Stratford, Ont.

Only FRAM can make these statements!



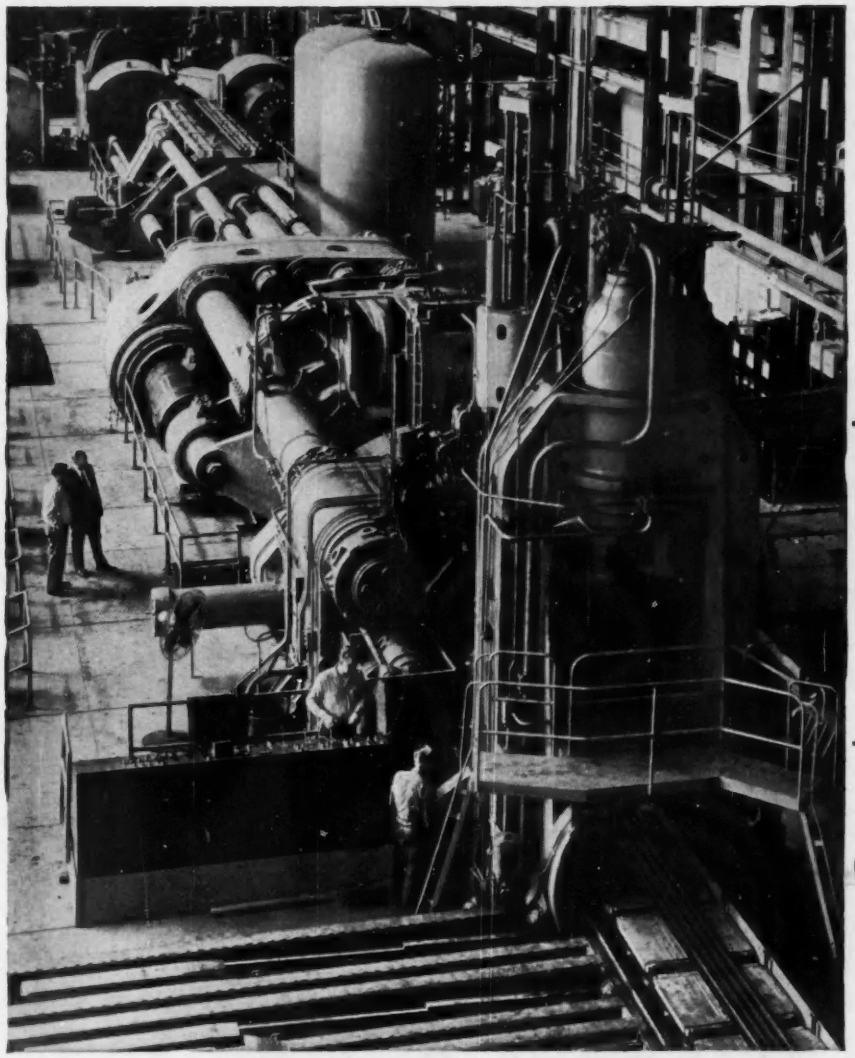
FRAM patented built-in gasket forms a perfect air-tight seal—no matter how often the cartridge is serviced, the unit is always perfectly sealed.



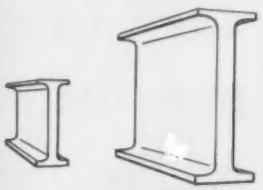
ALL air must pass through the filtering media. Once locked in place under slight pressure, this built-in gasket provides an absolute bond with the housing case.

New FRAM *FILTRONIC* Carburetor Air Filter is now original equipment on twenty-four 1957 engines!

Complete line of replacements for other cars equipped with a Filtronic Type Carburetor Air Filter

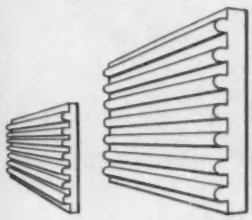


HOW THE 13,200-TON PRESS BOOSTS EXTRUSION CAPACITY



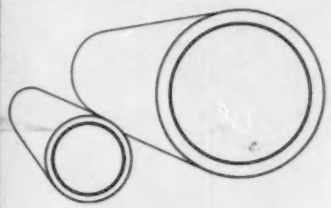
FROM 11" TO 28"

STRUCTURAL SHAPES



FROM 9" TO 20"

STIFFENED SECTIONS



FROM 10" TO 24" O.D.

TUBING

DOW'S NEW EXTRUSION PRESS PACKS 13,200-TON PUNCH

Here's a whole new range of large magnesium extrusions:
24-inch O. D. Tubing 28-inch I-Beams 80-foot-long sections

This mammoth press, newest addition to The Dow Chemical Company's rolling and extrusion mill at Madison, Illinois, is the world's largest magnesium extrusion facility. Its vastly increased capacities afford new opportunities for designers working with light metals. A wide variety of new magnesium applications for aircraft, missile, military and general industrial use are now possible and practical. In addition to extruding magnesium, the press is also available for large aluminum extrusions.

Here's how the big press will increase maximum dimensions of representative magnesium extrusions: Integrally stiffened sections, from 9 to 20 inches wide; I-Beams from 11 to 28 inches high; round tubing from 10 to 24 inches outside diameter; and maximum lengths of 80 feet. A large number of shapes and forms can be produced, limited only by the design of the die through which the metal is extruded. Many complex shapes that formerly required separate operations can now be formed in one operation.

If your design calls for large magnesium or aluminum extrusions, contact the nearest Dow Sales Office or write to THE DOW CHEMICAL COMPANY, Midland, Michigan, Department MA 1406D-1.

YOU CAN DEPEND ON DOW

Whatever the cargo or job— these fleets . . .



Photo courtesy of Gerlinger Carrier Co.



Photo courtesy of the White Motor Co.

roll up steady profits with dependable

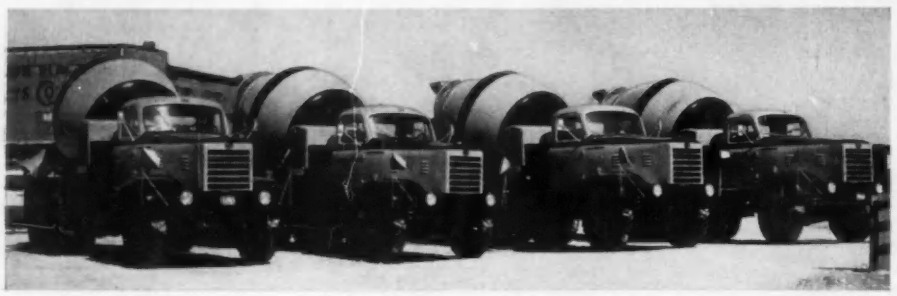


Photo courtesy of the Four Wheel Drive Auto Co.

BLOOD BROTHERS Propeller Shafts

Here are fleets of three kinds . . . each specialized for its purpose. But all three have one advantage in common. They're all equipped with rugged, dependable Blood Brothers Propeller Shafts.

The reason is simple. Blood Brothers Propeller Shafts have proved they will deliver maximum engine torque smoothly—and give outstanding trouble-free service year-after-year.

Seldom requiring attention, they make a hit with profit-minded fleet owners. So—whether you build trucks or operate them—you can depend on Blood Brothers Propeller Shafts to help keep down-time *down* and fleet earnings *up!*

Write now for specific data—we'll gladly cooperate.

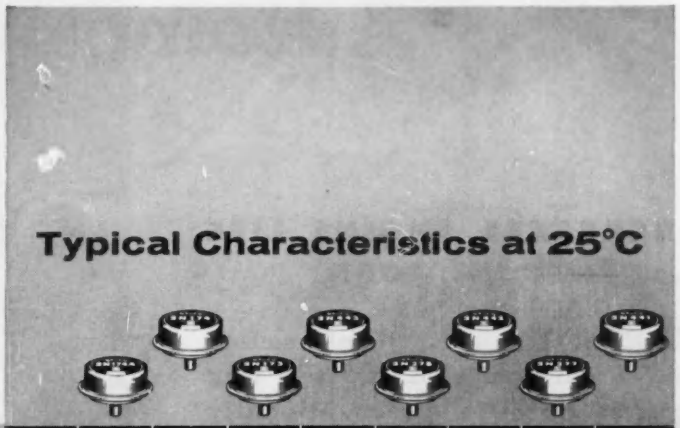


BLOOD BROTHERS MACHINE DIVISION
ROCKWELL SPRING AND AXLE COMPANY
ALLEGAN, MICHIGAN

UNIVERSAL JOINTS AND DRIVE LINE ASSEMBLIES

DELCO'S FAMILY OF HIGH POWER TRANSISTORS





Typical Characteristics at 25°C

	DT100	**2N174A	2N174	2N173	2N443	2N278	2N442	2N277	2N441
Maximum Collector Current	13	13	13	13	13	13	13	13	13 amps
Maximum Collector Voltage (Emitter Open)	100	80	80	60	60	50	50	40	40 volts
Saturation Voltage (13 amp.)	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7 volts
Max. Square Wave Power Output at 400 ~ P-P*	400	310	310	225	225	180	180	135	135 watts
Max. Sine Wave Power Output at 400 ~ P-P*	180	140	140	100	100	80	80	60	60 watts
Power Dissipation (Stud Temperature 25°C)	70	70	70	70	55	55	55	55	55 watts
Thermal Gradient from Junction to Mounting Base	1.0°	1.0°	1.0°	1.0°	1.2°	1.2°	1.2°	1.2°	1.2° °C/watt
Nominal Base Current I_B (V_{EC} = —2 volts, I_C = —1.2 amp.)	-19	-19	-19	-13	-24	-13	-24	-13	-27 ma

*Adequate Heat Sink

**Designed to meet MIL-T-19500/13 (USAF) 18 JUNE 1957

Offer a wide range of performance characteristics to meet your switching, regulation or power supply requirements

These nine Delco Radio alloy junction germanium PNP power transistors are now in volume production. They are characterized by high output power, high gain, and low distortion. And all are normalized to retain superior performance characteristics regardless of age.

Check the data chart above—see how they fit your particular requirements in current switching, regulation or power supply. Write for detailed information and engineering data. Delco Radio maintains offices in Newark, N. J. and Santa Monica, Calif. for your convenience.

DELCO RADIO
Division of General Motors
Kokomo, Indiana

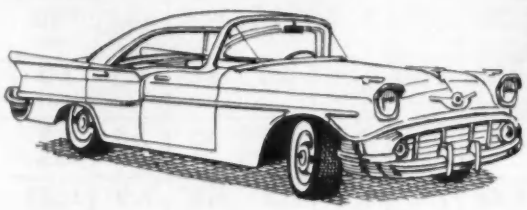
Rapidly becoming the

Standard of the Automotive Industry

INCREASES ENGINE LIFE UP TO 400%

STERLING'S great "Conformatic" piston with "Intra-Cast" steel ring groove liners give sensationally longer life to rings and grooves—

Recommended clearances for "Conformatic" pistons are from 0 to ½ thousandth inch. This clearance is maintained hot and cold providing unbelievable bore stability.

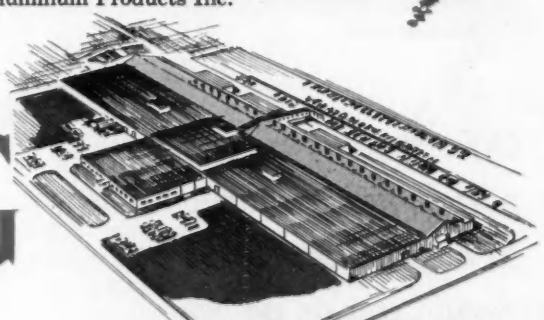


Sterling's revolutionary *Conformatic* piston already has been accepted and is now being used in a number of America's finest and most popular passenger cars.



STERLING'S CONFORMATIC PISTON WITH INTRA-CAST STEEL LINED GROOVES

prevents frictional horsepower loss, reduces oil consumption to an absolute minimum, and prolongs engine life up to 400%. *Intra-Cast* and *Conformatic* are registered trade names of STERLING Aluminum Products Inc.



NEW MANUFACTURING FACILITIES FOR STERLING ALUMINUM

120 acres! Completely new automated plant at the confluence of the Missouri and Mississippi Rivers

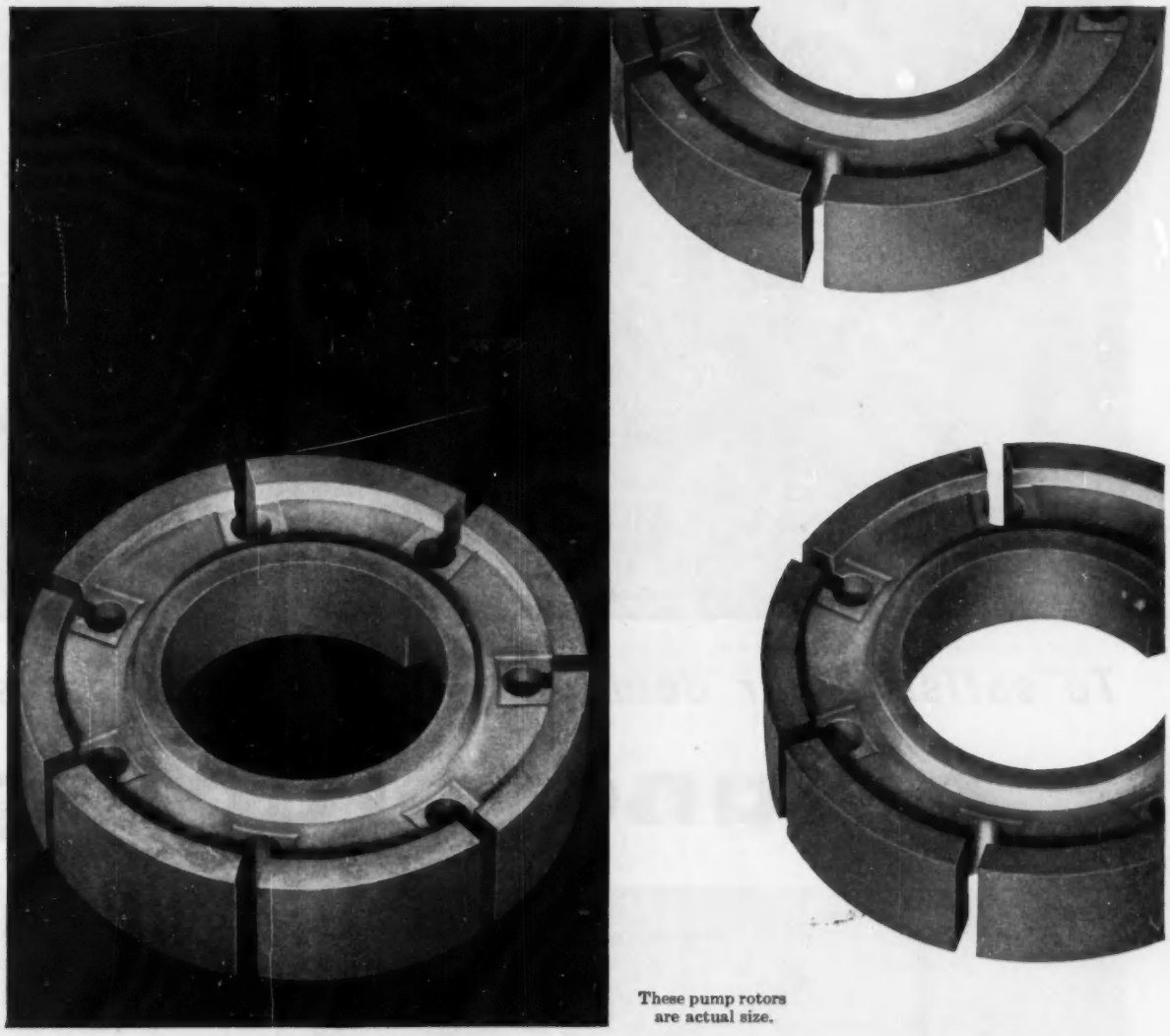
SA-1

STERLING

ALUMINUM PRODUCTS INC.

ST. CHARLES, MISSOURI

WORLD'S LARGEST MANUFACTURER OF ALUMINUM ALLOY PISTONS



These pump rotors are actual size.

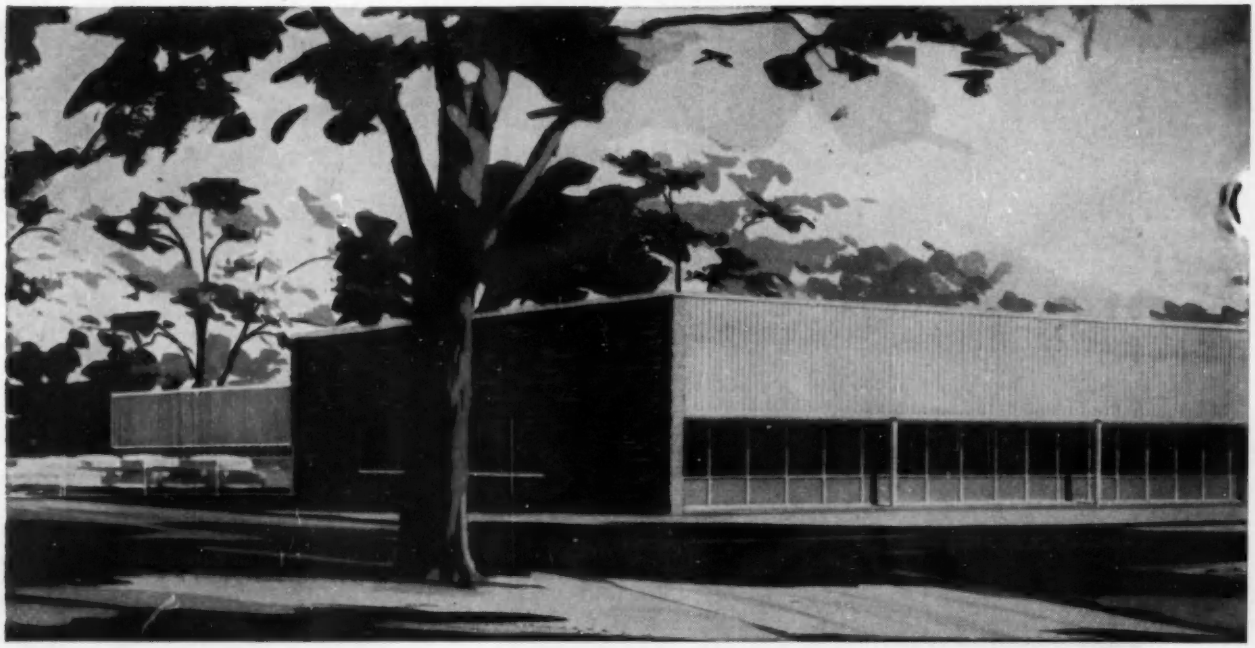
Just how *strong* are metal powder parts?

Metal powder parts by Moraine Products prove their strength and stamina every day on a wide variety of jobs. Take the automatic transmission pump rotors that are shown above. Millions of them perform efficiently and dependably *billions* of times during the life of the transmissions in which they are used. Rugged long-lasting metal powder parts by Moraine Products are the modern economical answer for an ever-increasing number of applications.

Moraine Products also produces: Moraine Power Brakes • Delco hydraulic brake fluids, brake assemblies, master cylinders, wheel cylinders, and parts • Moraine friction materials • Moraine-400 and M-100 automotive engine bearings • self-lubricating bearings and porous metal filters • rolled bronze and bi-metal bushings.

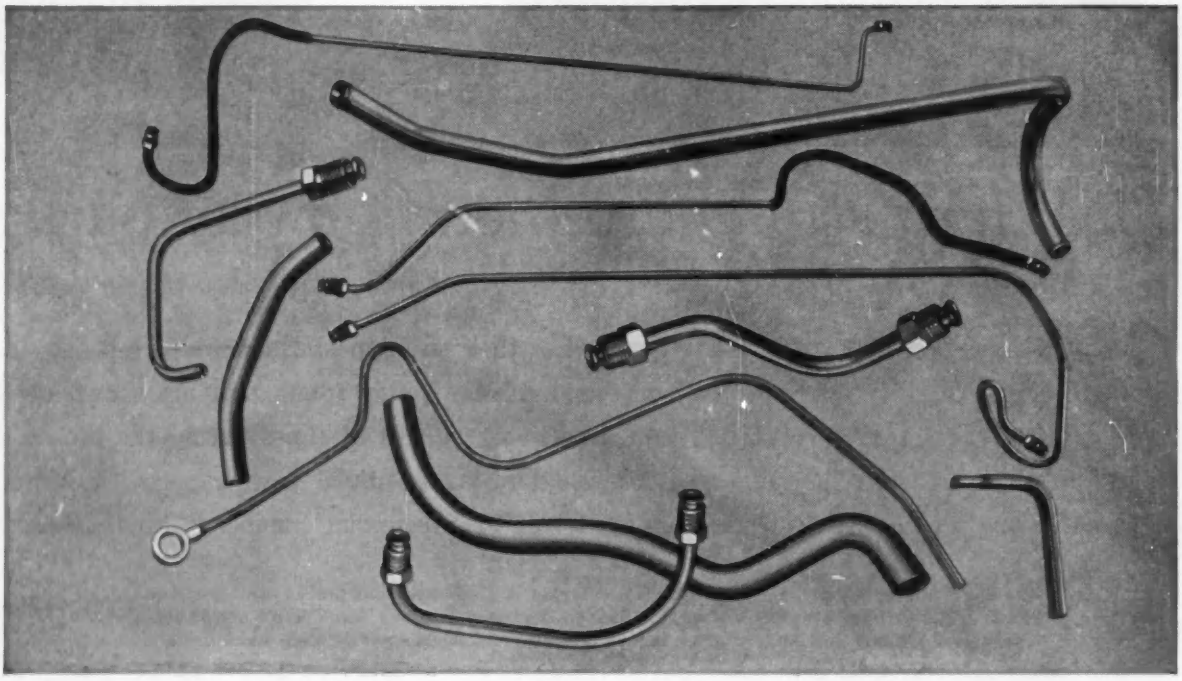
GM FORWARD FROM FIFTY

Moraine Products
Division of General Motors, Dayton, Ohio

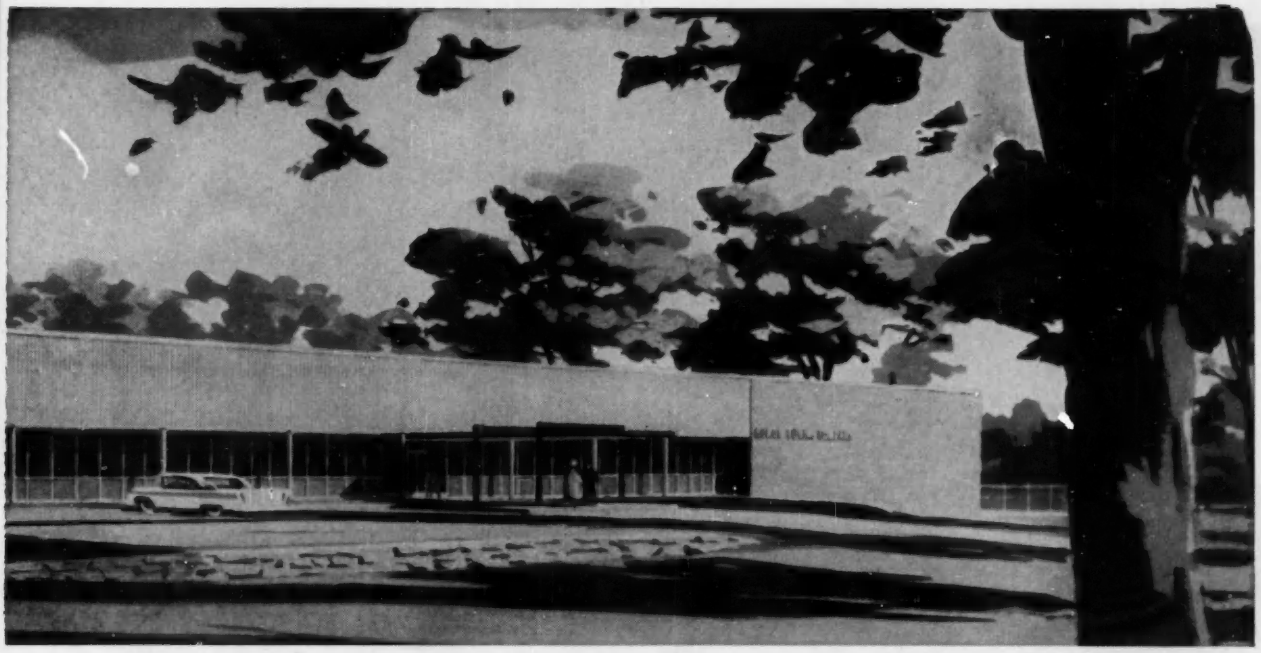


To satisfy your demand for fabricated parts:

Bundy Tubing



These typical automotive tubing parts now are in mass production at Bundy's new Winchester Division. Strong, leakproof Bundyweld Tubing, fabricated into a variety of complex shapes, *is used on 95% of today's cars, in an average of 20 applications each.*



Winchester Division, Bundy Tubing Company's newest plant, has 103,500 square feet of floor space devoted exclusively to fabricating parts from famous Bundyweld® Tubing.

expands again

New Winchester Division devotes 103,500 sq. ft. of floor space to high-speed, precision manufacture of parts from Bundyweld!

Bundy's new air-conditioned fabrication plant in Winchester, Ky., is open. And its every square inch has been planned, tooled and staffed to give you famous Bundy® precision and high quality in fabricated tubing parts . . . at low, mass-production costs.

Winchester Division now offers you all these:

Modern equipment—New machines fabricate tubing parts quickly, precisely, economically.

Experienced personnel—Highly trained production operators . . . long-time Bundy men in key supervisory slots.

Tight quality-control—Rigid inspection holds your specifications exactly . . . maintains your quality standards.

On-time deliveries—Modern equipment insures efficient handling, prompt shipment. Plant is strategically located . . . easy to reach by truck from major highways.

Winchester Division joins Bundy's other production and fabrication plants to give you low-cost, blueprint-to-assembly service on whatever you need in small-diameter tubing or fabricated tubing parts. Find out how *you* profit from Bundy's growth. Call, write, or wire us today.

BUNDY TUBING COMPANY, DETROIT 14, MICHIGAN

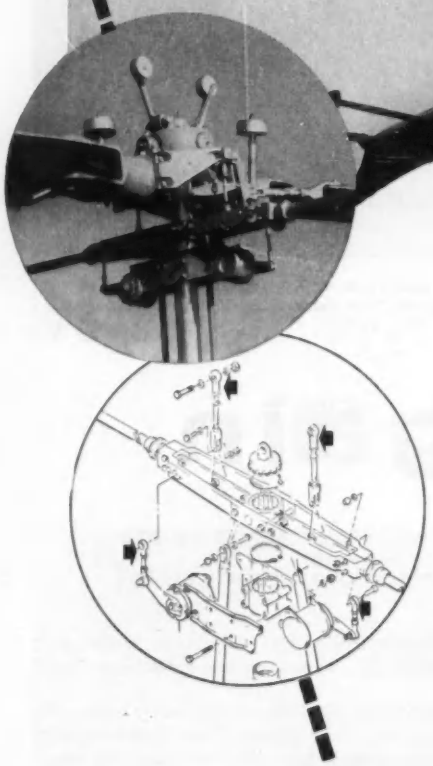
WORLD'S LARGEST PRODUCER OF SMALL-DIAMETER TUBING • AFFILIATED PLANTS IN AUSTRALIA, ENGLAND, FRANCE, GERMANY, AND ITALY

There's no real substitute for

BUNDYWELD® TUBING

Bundy Tubing Distributors and Representatives: *Massachusetts:* Austin-Hastings Co., Inc., 226 Binney Street, Cambridge 42 • ***New Jersey:*** Atlantic Tube & Metals, Inc., P.O. Box 595, Mountain View • ***Pennsylvania:*** Rutan & Co., 1 Bala Ave., Bala-Cynwyd • ***Midwest:*** Lapham-Hickey Steel Corp., 3333 W. 47th Place, Chicago 32, Ill. ***South:*** Peirson-Deakins Co., 823-824 Chattanooga Bank Bldg., Chattanooga 2, Tenn. • ***Southwest:*** Vinson Steel & Aluminum Co., 4606 Singleton Blvd., Dallas, Texas ***Northwest:*** Eagle Metals Co., 4755 First Avenue South, Seattle 4, Wash. • ***Far West:*** Pacific Metals Co., Ltd., 2187 S. Garfield, Los Angeles 22, Calif., Pacific Metals Co., Ltd., 1900 Third Street, San Francisco 7, Calif. **Bundyweld nickel and Monel tubing are sold by distributors of nickel and nickel alloys in principal cities.**







THE NEW "BELL RANGER" HELICOPTER USES HEIM UNIBAL ROD ENDS

Model 47-J is the latest helicopter to be introduced to the commercial market by Bell Helicopter Corp., and has been named the Bell Ranger. It is a four-place, executive type machine with a deluxe interior or a series of quick-change cabin arrangements for cargo, litter, and internal hoist configurations.

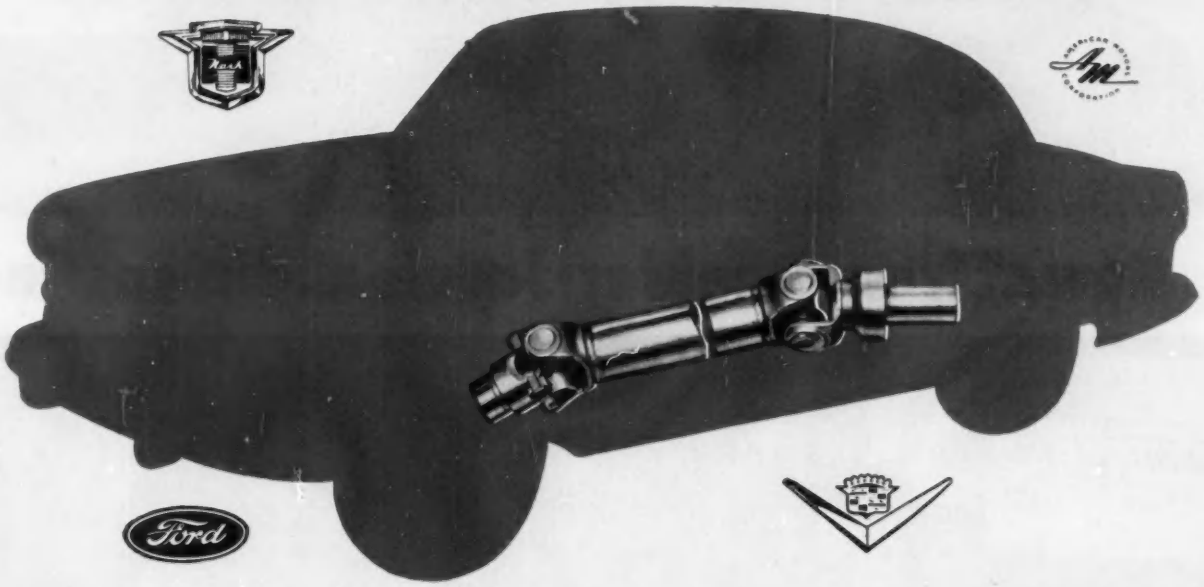
HEIM Unibal Rod Ends were chosen for the linkages in the carburetor heat and mixture control installations, and in the main rotor stabilizer bar assembly. The rods link hydraulic dampers to the bar, which provides exceptional stability to the flight characteristics of Bell helicopters, acting like a gyroscope and, through mixing levers, keeps the rotor plane of rotation in its pre-established flight path.

THE HEIM *Unibal* is the spherical bearing which corrects misalignment in every direction because of the universal movement of the ball — Reduces friction and lost motion in linkages — Eliminates the effects of vibration — Lowers assembly costs because of its quick and easy installation — Carries heavier loads.

Perhaps Heim can help solve — or simplify — your linkage problems. Feel free to write. Be sure each engineering and purchasing department has a Heim catalog.

THE HEIM COMPANY / Fairfield, Connecticut

COMPETENT

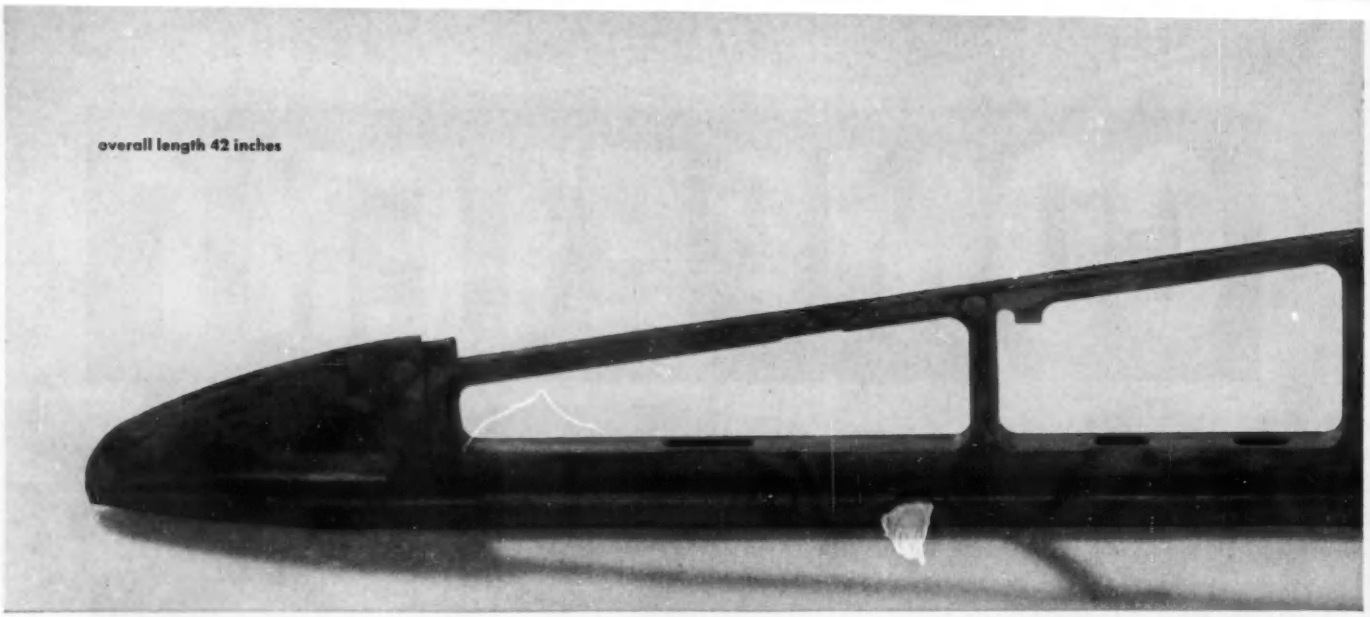


For the very latest in design and highest quality workmanship — America's leading automobiles, from the smallest to the largest, rely on MECHANICS. MECHANICS drive lines are engineered to meet each customer's specific needs. Torque, size, weight, balance, angularity, runout, safety, lubrication, assembly and service problems all have been overcome — to each customer's complete satisfaction. Let us help engineer joints and drive lines to fit Your products.

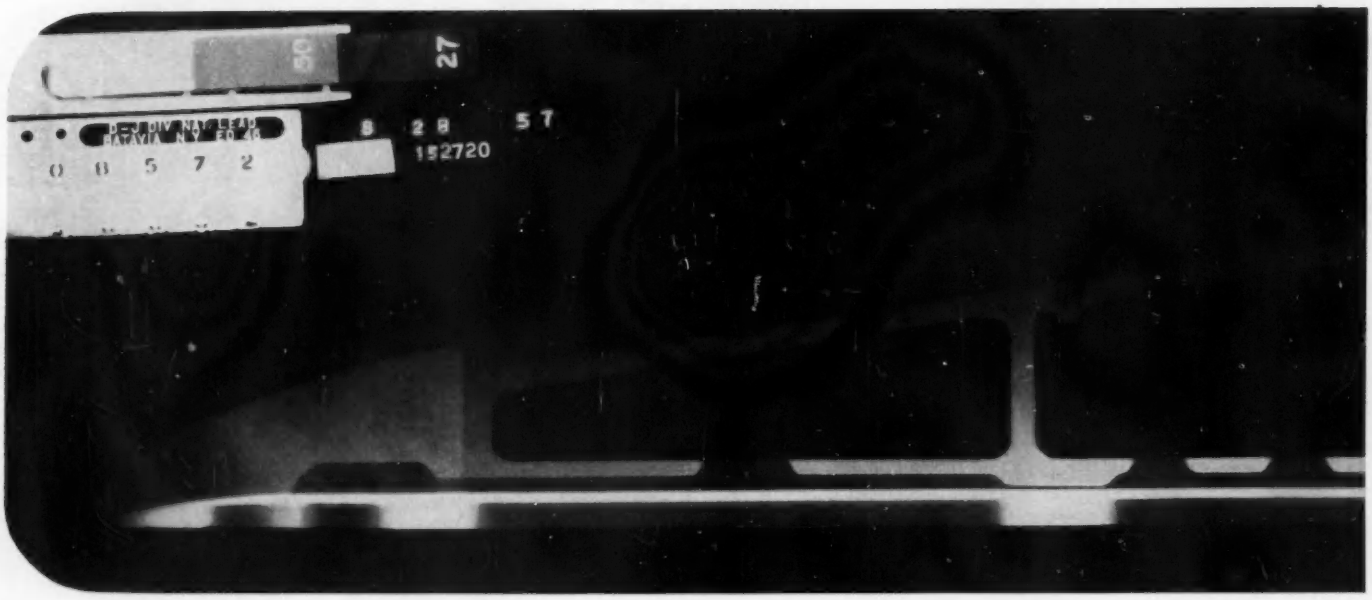
MECHANICS UNIVERSAL JOINT DIVISION
Borg-Warner • 2022 Harrison Ave., Rockford, Ill.
Export Sales: Borg-Warner International
79 E. Adams, Chicago 3, Illinois

MECHANICS
Roller Bearing BW
UNIVERSAL JOINTS

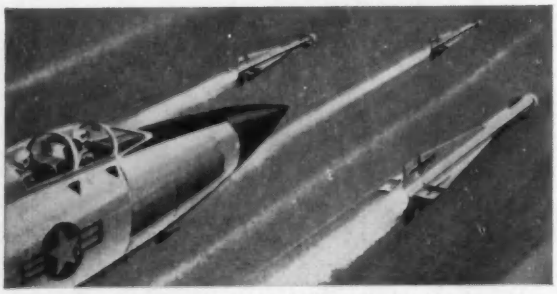
For Cars • Trucks • Tractors • Farm Implements • Road Machinery •
Aircraft • Tanks • Busses and Industrial Equipment



Now...from Doehler-Jarvis...die castings



X-ray of the Falcon's fin proves



The Falcon is an air-to-air missile built by Hughes Aircraft Company for the U. S. Air Force. Its light weight die cast stabilizer fins resist severe strain during course changes. It uses other Doehler-Jarvis die castings also.

Now *you* can have structurals die cast to standards as high as those for primary aircraft structurals*.

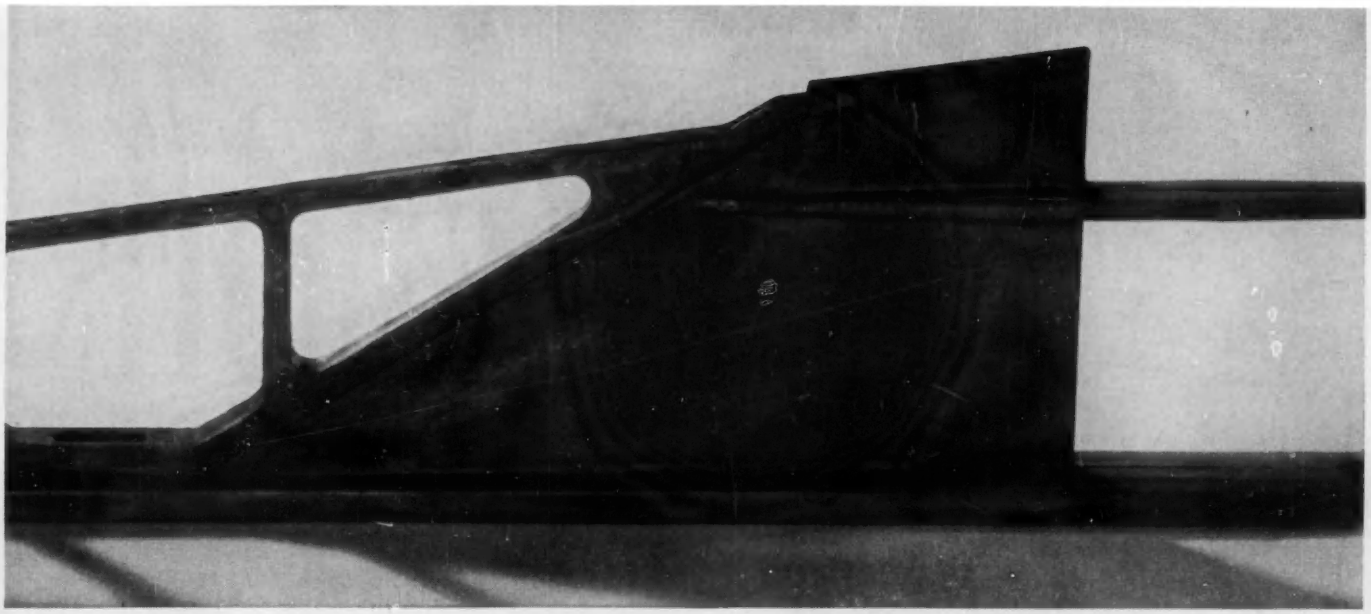
Die cast! With all the economy, precision, surface superiority, ease of assembly that implies. Die cast of aluminum, or of a high-purity magnesium alloy, like the 42" Falcon stabilizer fin.

They said it couldn't be done!

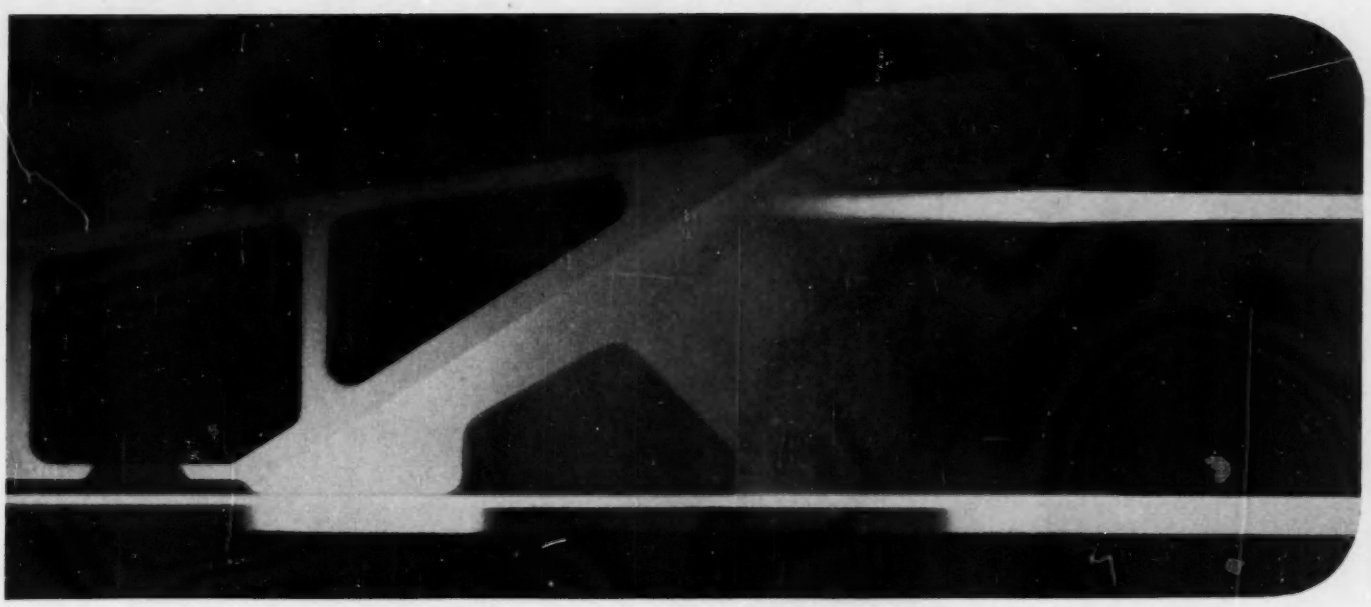
But there you see such a structural! Along with X-ray proof of soundness, uniformity, primary-aircraft-structural* quality.

Mind you! The Falcon fin is in commercial production. Doehler-Jarvis has die cast thousands. Each has had to pass 73 inspections before acceptance . . . including 100% X-ray.

In *one* control, sections of castings are continuously tested for tensile strength. In this examination of physical properties, the castings normally exceed tensile specifications by 15% or



of primary-aircraft-structural* quality



their uniformity and soundness

more. Quality is so high there has never been a single test below specification.

How did this come about?

Like many developments in die casting, this one started with a customer's need . . . Hughes Aircraft's.

They, and the Armed Services, needed such castings. The parts *might* be made other ways. But at what cost! What sacrifice in weight — and materials! If it *could* be die cast, if there *were* a magnesium alloy able to stand supersonic air stresses . . .

It took a while. But, with close cooperation from engineers of both Doehler-Jarvis and Hughes, the way was found.

Now you can list die castings of primary-aircraft-structural* quality among D and J availabilities. Get them from any Doehler-Jarvis plant.

*A primary aircraft structural is a major load-bearing component member any single failure of which would result in loss of the aircraft.

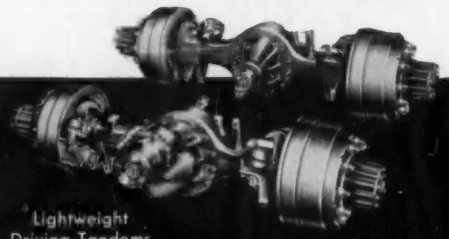
Doehler-Jarvis
DIVISION OF NATIONAL LEAD COMPANY
General Offices: Toledo 1, Ohio

In Canada:
Barber Die Casting Co. Limited
Hamilton, Ontario

For Today's Most Complete Line of Quality

SPECIFY...

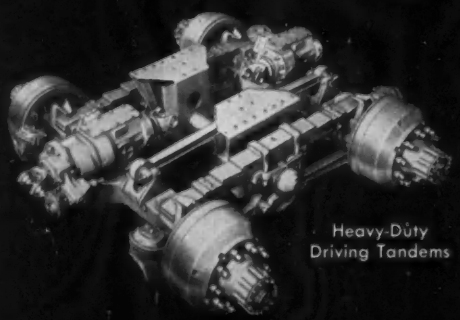
TIMKEN-DETROIT®



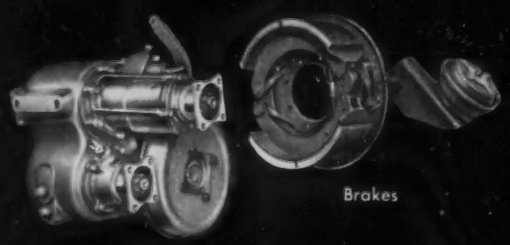
Lightweight Driving Tandems



Trailer Axles



Heavy-Duty Driving Tandems

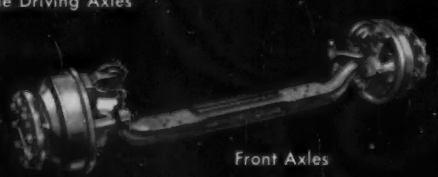


Brakes

Gear Boxes



Single Driving Axles



Front Axles

Whether your requirements call for highway or off-the-road equipment—Timken-Detroit offers torture-tested axles and brakes proven by almost 50 years of field testing and laboratory research!

Timken-Detroit meets all your requirements for driving, trailer and front axles . . . brakes and gear boxes . . . with a complete range of capacities in each product category. Shown here are some of the units included in the complete line.

Nearly 50 years of manufacturing experience—plus continuing field and laboratory research—have taught Timken-Detroit the exacting needs of the trucking industry. Timken-Detroit Axles and Brakes are designed and built to give you the utmost in service, safety and dependability.

To you—this leadership in power transmission and braking systems means more productive road time, reduced operating costs and lower maintenance expense. Timken-Detroit Axles and Brakes are engineered to carry more payload . . . and stop more payload . . . at lower operating costs under all conditions.

The Timken-Detroit line of Medium and Heavy Duty Double-Reduction Tandems is an example of the superior engineering features and quality built into every Timken-Detroit product.

Plants at: Detroit, Michigan • Oshkosh, Wisconsin • Utica, New York
Ashtabula, Kenton and Newark, Ohio • New Castle, Pennsylvania

TIMKEN *Detroit* AXLES

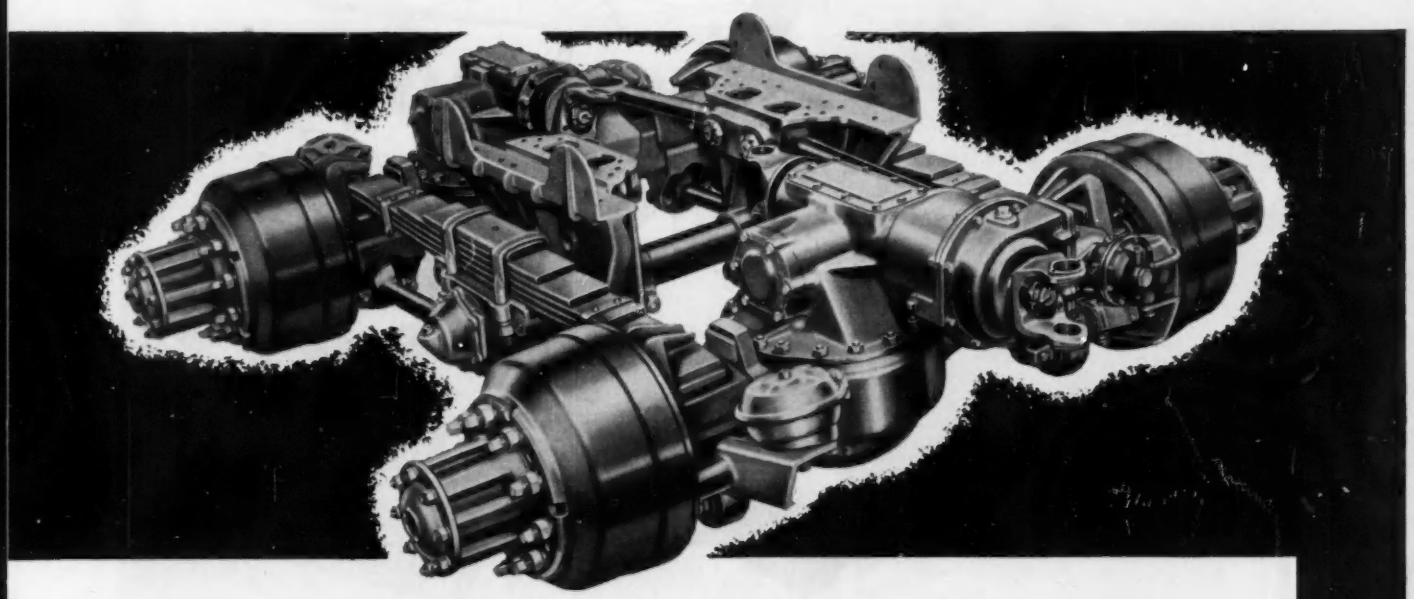
TIMKEN-DETROIT AXLE DIVISION
ROCKWELL SPRING AND AXLE COMPANY
DETROIT 32, MICHIGAN

Accepted D A Standard

TRADE MARK REGISTERED

Axles and Brakes for Commercial Vehicles

Products of Rockwell Spring and Axle Co.



Timken-Detroit Heavy-Duty Double-Reduction Tandems Give You Payload Leadership!

Ability to take the toughest going and still deliver the load on time has helped make these rugged tandems the number one choice with operators of heavy-duty vehicles. These tandems give you the big advantages of long trouble-free service, economical performance and utmost dependability.

Here are a few of the features developed in famous Timken-Detroit Tandem Drive Units—

"Cradle Ride" Suspension...free ends of long, resilient springs float in axle spring guide brackets. This permits axles to articulate freely, adjusting themselves to road irregularities. Floating springs cradle the vehicle, materially reducing road shock and eliminating source of vehicle flutter. "Cradle Ride" suspension stabilizes the load, permits easy, restful driving . . . improves driver control and safety. Driving and braking forces are transmitted only through torque rods.

Hypoid Gears with their larger pinions and greater tooth contact give you outstanding performance, top efficiency and long life—plus lower maintenance costs.

Inter-Axle Differential divides torque evenly between axles . . . yet permits wheels of one axle to turn faster or slower than wheels of the other axle. This means both axles are always doing equal amounts of work. Driving parts and tires last longer. Controlled from the cab, differential can be locked out at any speed to give positive through drive.

Rectangular Shaped Axle Housings are forged from high carbon steel. This rectangular shape, combined with full strength corner sections, provides the greatest strength possible with minimum weight and size.

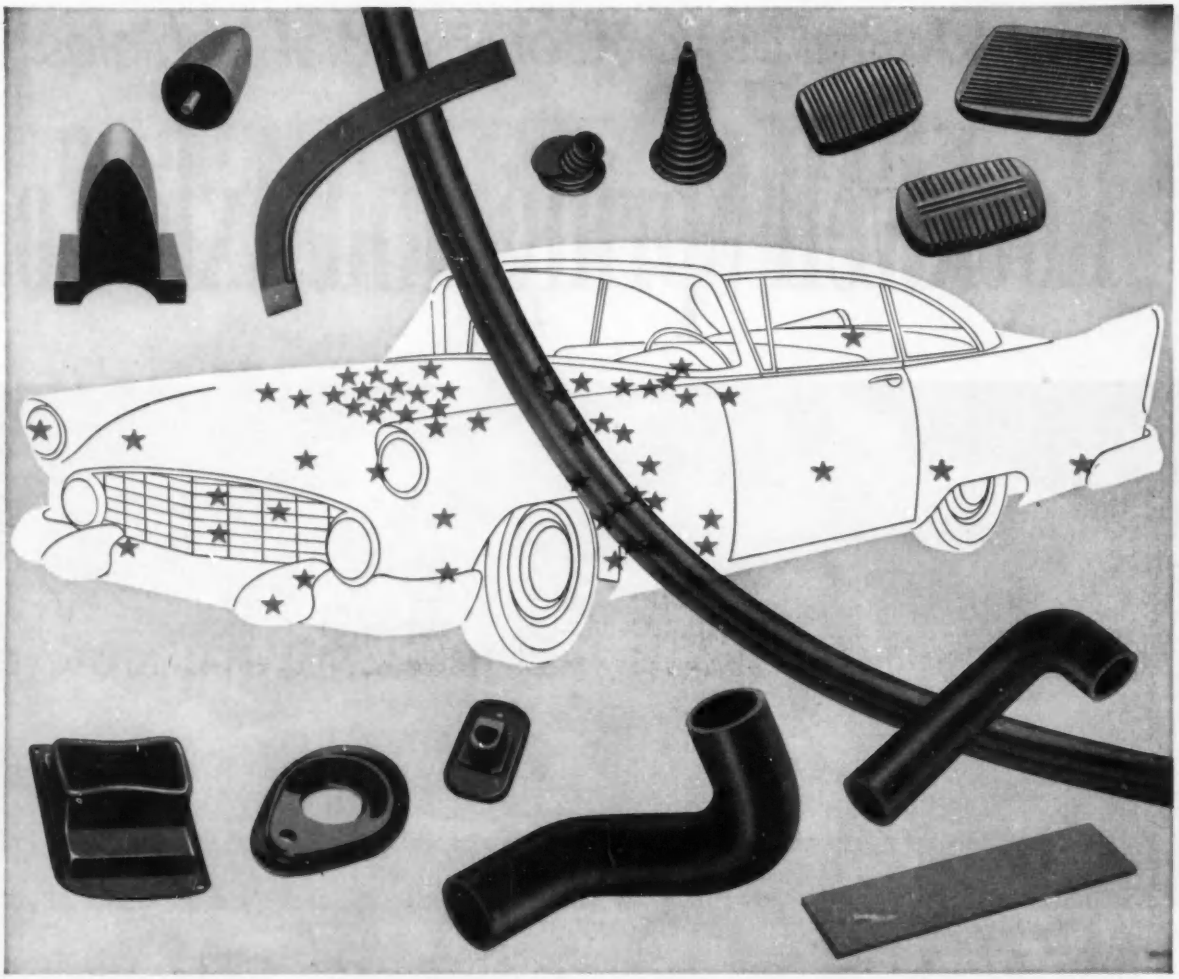
Famous Torsion Flow Axle Shafts are made even stronger through the use of more splines and greater root and body diameter.

Dependable Heavy Duty "P" Series Air Brakes with unit-mounted design make a compact self-contained assembly. Temperatures are lower and liner life is longer because of open type spiders. Tapered "Econo-liners" provide greatest thickness in area of greatest wear.

Unequaled parts interchangeability gives you more time on the road—reduces parts inventory—speeds service. Parts are standard items readily available.

©1957, RS&A Company

WORLD'S LARGEST MANUFACTURER OF AXLES FOR TRUCKS, BUSSES AND TRAILERS



★ some of the more than 100 places where ENJAY BUTYL works, silently and dependably, helping to improve the performance of today's new cars.

ENJAY BUTYL— fabulous all-weather rubber
BOOSTS PERFORMANCE IN '58 CARS

Molded into more than 100 parts, this super-durable, all-weather rubber helps provide a steadier, softer, more silent ride under even the most strenuous conditions of stress, weather change, and abrasive action. The dependability of all these parts contributes to the outstanding performance of the modern car.

Readily available in non-staining grades, Enjay Butyl rubber can be compounded into white and light-colored parts that combine beauty with top-notch performance. Low in cost, it out-performs and out-lasts all other rubbers formerly used, and may well be able to *cut costs* and *improve performance* in *your* product. For further information, and for expert technical assistance, contact the Enjay Company.

ENJAY BUTYL

Enjay Butyl is the greatest rubber value in the world . . . the super-durable rubber with *outstanding* resistance to aging • abrasion • tear • chipping • cracking • ozone and corona • chemicals • gases • heat • cold • sunlight • moisture.

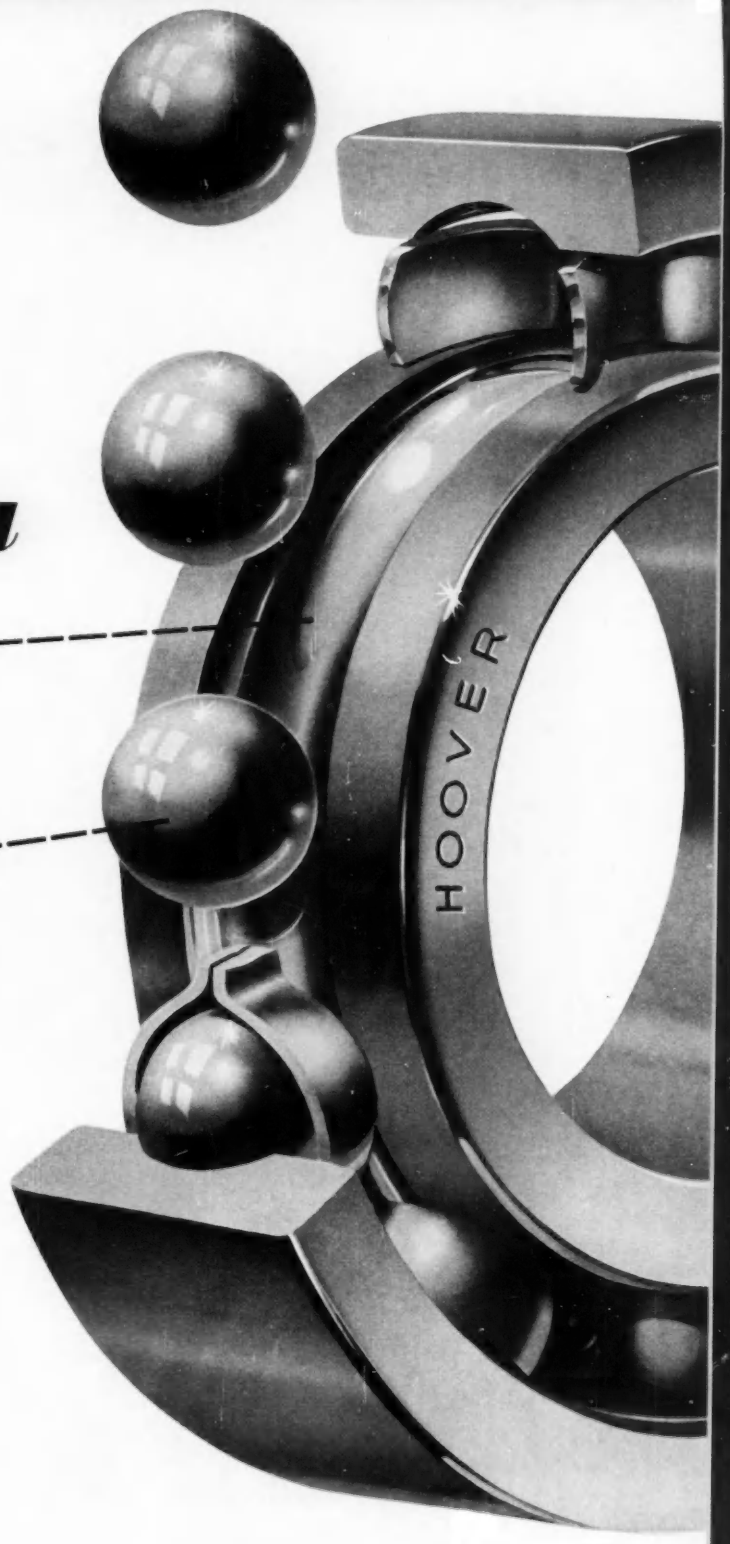
ENJAY

Pioneer in Petrochemicals

ENJAY COMPANY, INC., 15 West 51st Street, New York 19, N. Y.

Akron • Boston • Chicago • Detroit • Los Angeles • New Orleans • Tulsa

only hoover gives you



Hoover Honed Raceways

which are not only ground, but also fully honed with a unique process developed and used only by Hoover. The result: super smooth, superbly finished raceways of microscopic accuracy and perfection.

Micro-Velvet Balls

made of the finest of selected high carbon chrome alloy steel, uniformly hardened throughout, then surface finished so perfectly that roundness and diameter are accurate within *millionths* of an inch! The gleaming surfaces are absolutely free of even the tiniest of defects.

Perfectly Matched

ball complements are fitted into perfectly matched raceways . . . a final quality step that pays off in maximum load capacity, hushed quietness and extra long life for which Hoover Ball Bearings are so well known. Bearing types available: single row, single and double shield, combination felt seal and shield, double row, cartridge, single and double contact seal.

Hoover Honed and *Micro-Velvet* are Hoover Trademarks

hoover

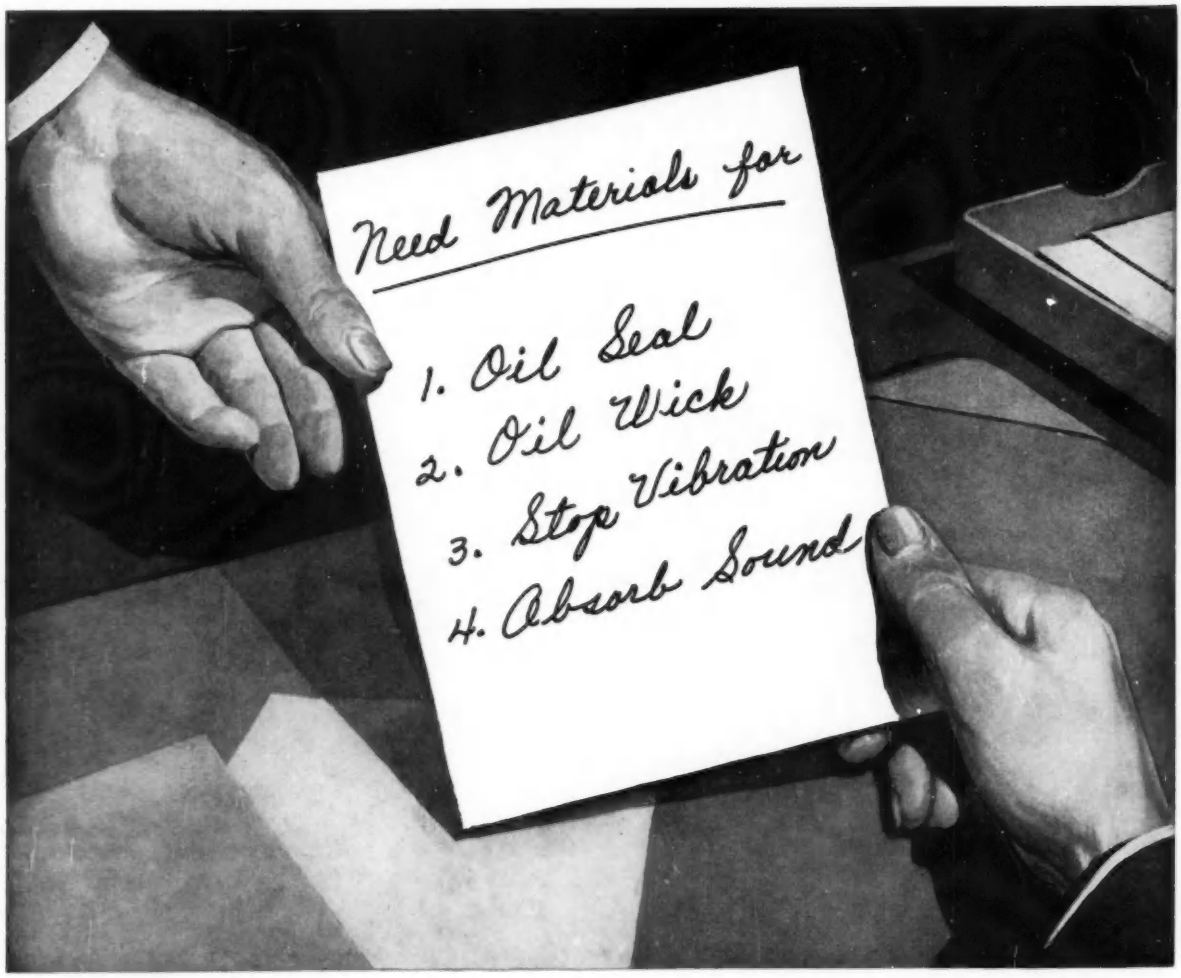
BALL AND BEARING COMPANY
ANN ARBOR, MICHIGAN

SALES OFFICE AND WAREHOUSE: 2020 SOUTH FIGUEROA, LOS ANGELES 7, CALIF.



WRITE FOR YOUR COPY OF THE HOOVER HANDI-BOOK OF ANTI-FRICTION BEARINGS.

Keep accurate, concise information at your fingertips to help you select proper bearings and solve bearing problems.



for all four Your best answer is

Felt

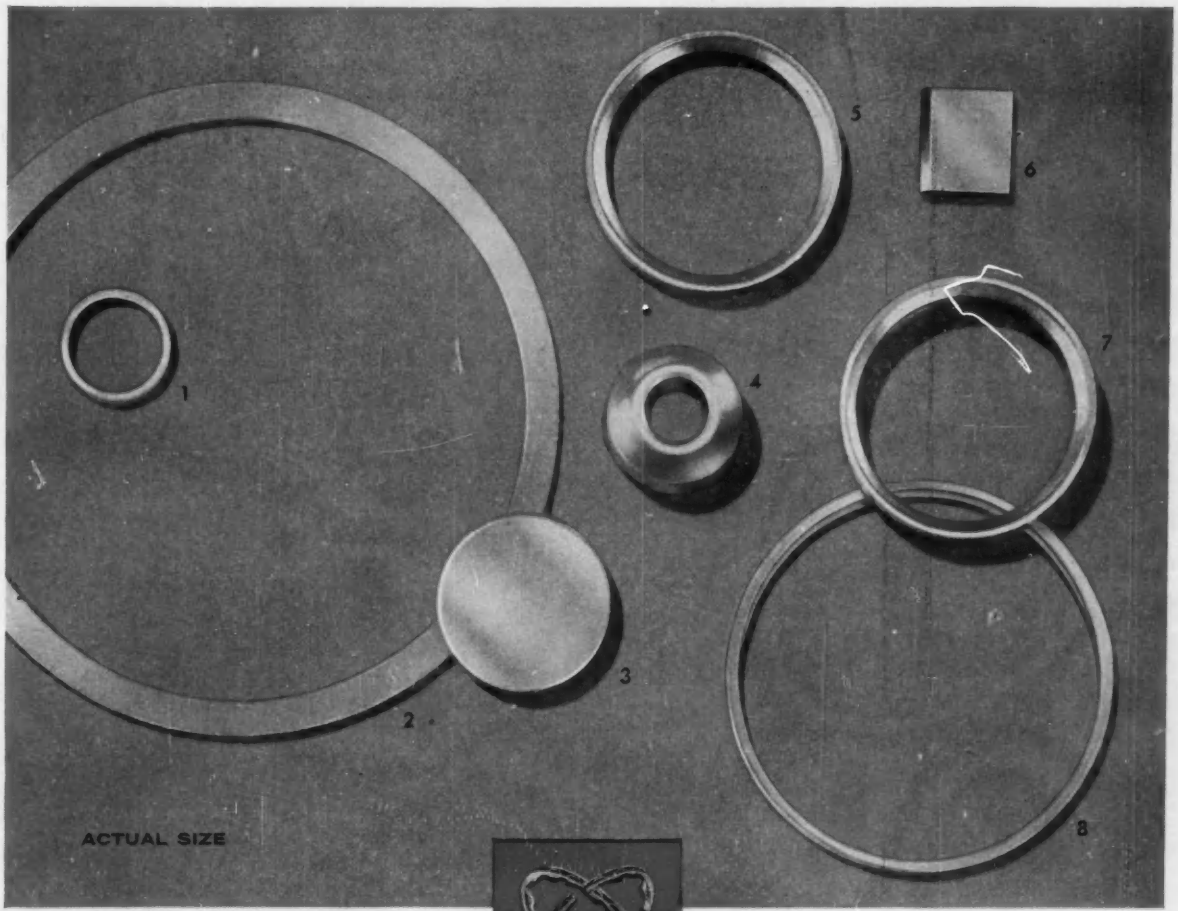
Western Felts can be made as soft as virgin wool or as hard as bone—or any desired specifications in between. But always, their live fibers hold their shape. They never ravel or fray . . . resist wear, age, and weather.

For over 56 years Western Felt has manufactured and cut specification felts for all industries. Whatever your problem, our experience can be helpful. Let our engineers investigate that possibility for you.

WESTERN
4021-4139 Ogden Ave
Chicago 23, Illinois
Branches in all Principal Cities

Felt **WORKS**

MANUFACTURERS AND CUTTERS OF WOOL FELT



From the producer of piston rings  used in 1 out of every 3 new cars . . .

New economies for you in powdered metal parts

Muskegon's Sparta Foundry—pioneer and foremost producer of sintered powdered metal piston rings—can form small sintered powdered metal sealing rings and parts for you at lower costs than ever before. Sparta's technological advancements and extensive production facilities make this possible.

In addition to the greater strength and longer wear, Sparta sintered powdered metal parts offer the advantages of smaller, narrower size with no trim or waste. Closer tolerances and more accurate measurements can be maintained, oil retention qualities can be improved. Savings in metal and machining are truly impressive.

(1) Small engine piston ring blank. (2) Automotive piston ring blank. (3) Finished valve pressure disc. (4) Rocker arm ball valve. (5) Automatic transmission ring blank. (6) Refrigerator compressor rotor blade. (7) Camshaft spacer ring. (8) Clutch spring retainer ring.

SEND FOR YOUR FREE SAMPLE KIT

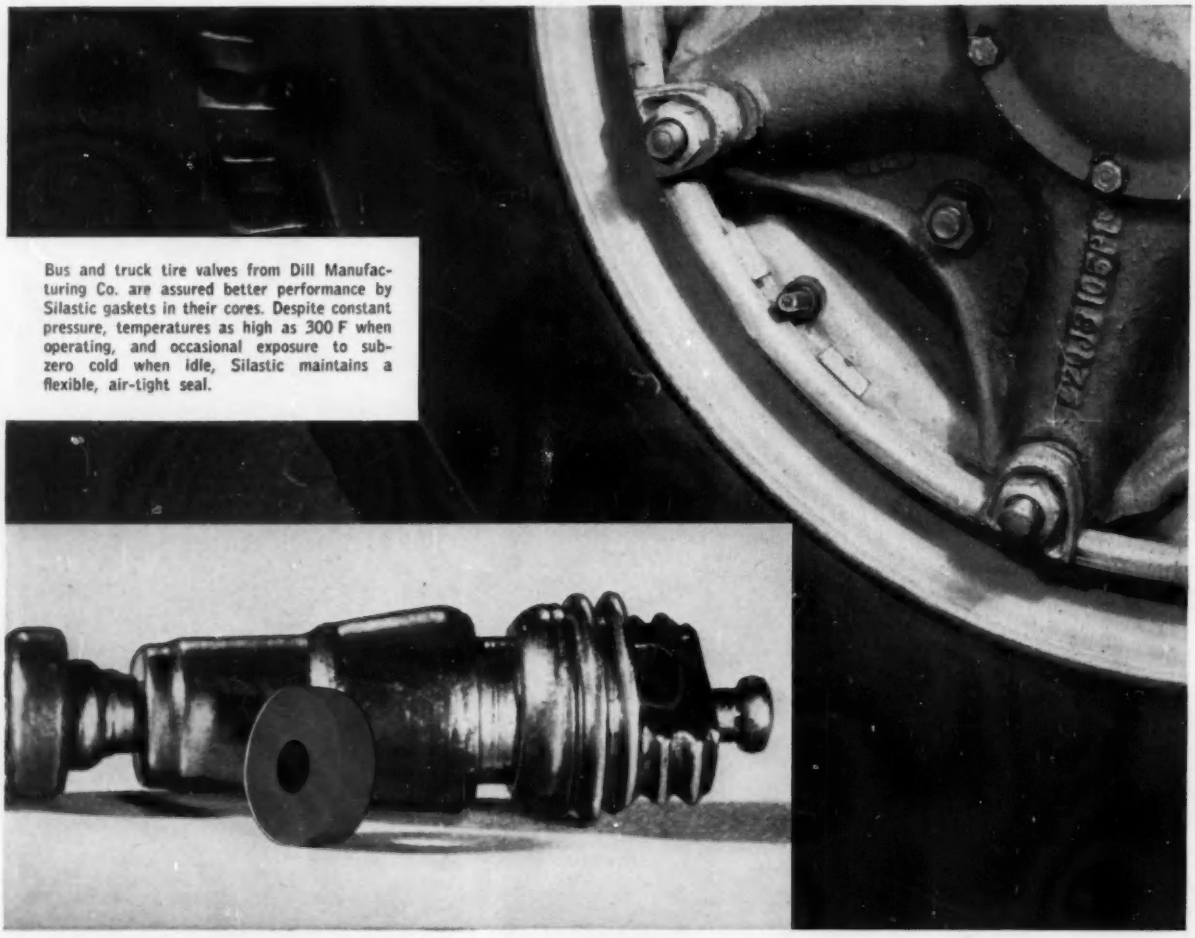
It contains a miniature assortment of precision sintered powdered metal parts and precision iron and bronze sand castings. These parts typify how Sparta can reduce or completely eliminate your finishing and machining operation. Write today! Sparta Foundry Co., Sparta, Mich.



MUSKEGON Piston Ring Co.

PLANTS AT MUSKEGON, MICHIGAN SPARTA, MICHIGAN ROTARY SEAL DIVISION PLANTS AT SPARTA, MICHIGAN CHICAGO, ILLINOIS

Since 1921... The engine builders' source!



Bus and truck tire valves from Dill Manufacturing Co. are assured better performance by Silastic gaskets in their cores. Despite constant pressure, temperatures as high as 300 F when operating, and occasional exposure to sub-zero cold when idle, Silastic maintains a flexible, air-tight seal.

SILASTIC
SILICONE RUBBER

resists heat, cold, high compression

For resistance to fuels, oils and solvents, specify Silastic LS

Where conditions are too severe for organic rubber, yet rubbery properties are needed, try Silastic*, the Dow Corning silicone rubber. Silastic stays resilient from —130 to 500 F, and has very low compression set at extreme temperatures. It resists moisture, weathering, most hot oils and has high dielectric strength. Leading rubber companies offer Silastic as calendered, extruded and molded parts in either solid or sponged form.

Get latest data on Silastic. Mail coupon today

Dow Corning Corporation, Dept. 9124
Midland, Michigan

Please send me latest data on Silastic

NAME _____

COMPANY _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____

*T.M. REG. U.S. PAT. OFF.

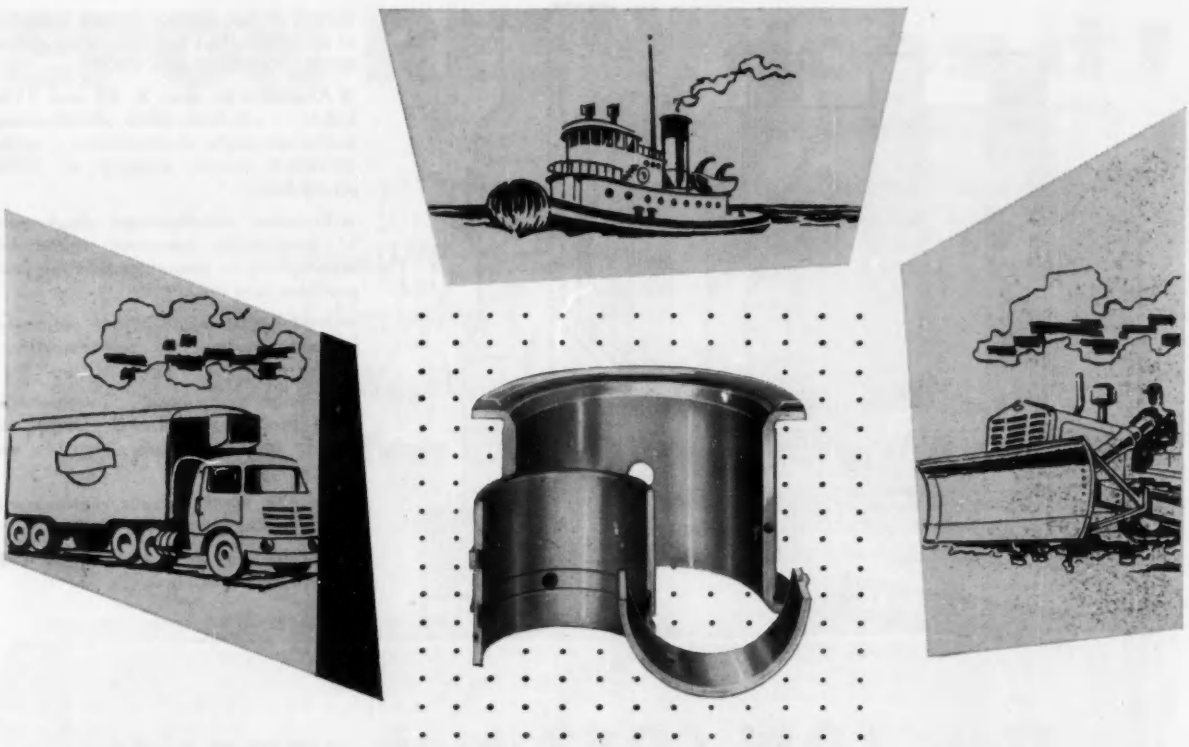
Typical Properties of Silastic for Molded Parts

• Temperature range, °F	—130 to 500
• Tensile strength, psi	600 to 900
• Elongation, %	150 to 300
• Compression set, %, @ 300 F	15 to 40
• Hardness range, durometer	20 to 90
• Dielectric strength, volts/mil	400 to 500
• Oil resistance	Dependent on type of oil

If you consider ALL the properties of a silicone rubber, you'll specify SILASTIC

first in silicones

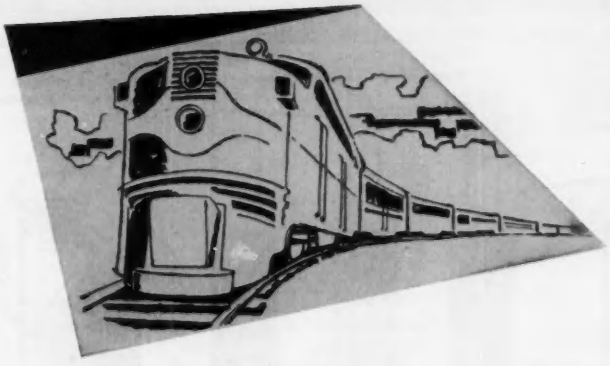
Dow Corning CORPORATION
MIDLAND, MICHIGAN



Higher Horsepower Demands the Greater Strength of JOHNSON Aluminum on Steel BEARINGS

With the trend in diesel engines toward ever higher horsepower, the permanently bonded aluminum on steel bearings developed by Johnson Bronze rapidly are becoming standard for heavy diesels. Designed to take loads as high as 5000 psi, they are ideal for heavy-duty, high-speed engines.

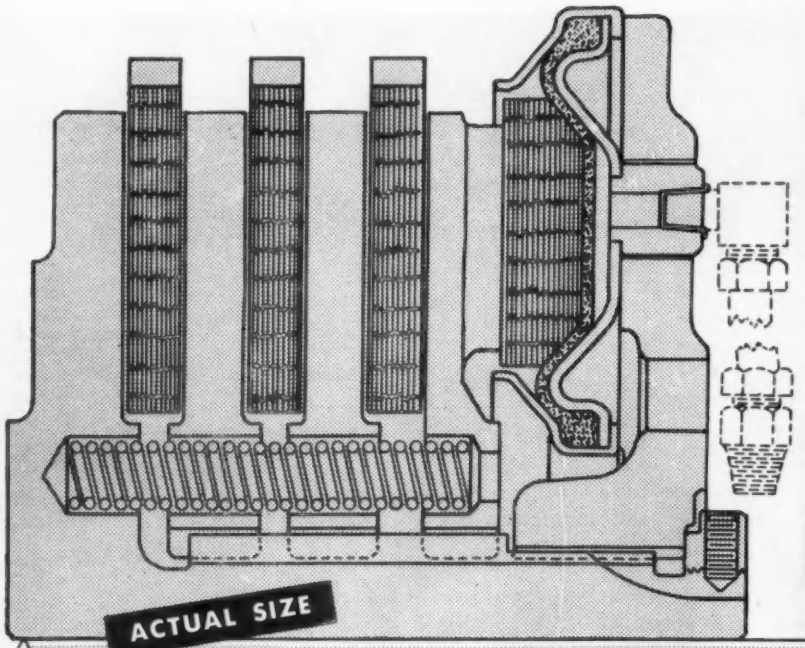
Johnson Bronze pioneered in the development of aluminum on steel bearings, and today is a leading supplier. We can furnish a wide range of plain or flanged, full or half bearings, with or without precision overlay. Take advantage of our years of experience and special production facilities—your Johnson Bronze representative will be glad to give you full details on how Johnson aluminum on steel bearings can improve your engine's performance. Johnson Bronze, 675 S. Mill Street, New Castle, Pa.



JOHNSON Bearings

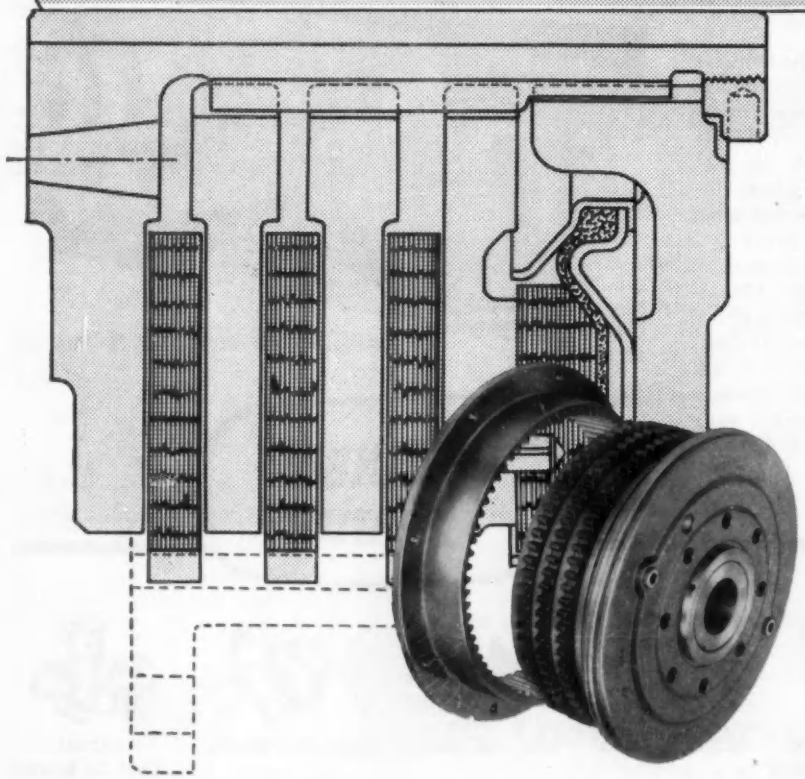


POWDER METALLURGY—BRONZE OR IRON | ALUMINUM ON STEEL CAST ALUMINUM ALLOY | BRONZE ON STEEL | STEEL AND BABBITT | GRAPHITED BRONZE | BRONZE—CAST OR ROLLED



- **New design permits highest capacity at up to 40% less cost than comparable remote controlled air clutches!**
- **Available in sizes 8, 10 and 11½ inches . . . in triple-plate, double-plate and single-plate construction . . . with maximum torque capacity of 3503 pound-feet.**
- **Exclusive cartridge-type diaphragm of long-lasting neoprene reinforced with nylon . . . eliminates leakage and provides long life.**
- **Provides constant torque capacity without adjustment . . . self-compensating for wear.**
- **Compact and rugged . . . with clutch mass properly distributed relative to friction area, providing long life on high energy loads.**
- **Narrow width permits replacement of old-style drum or band clutches.**
- **Suitable for air systems up to 130 pounds per square inch.**

New LOW COST high capacity Twin Disc Air Clutches



The new Twin Disc 8, 10 and 11½-inch PO Air Clutches are adaptable wherever the convenience of remote air control is desired. They are currently in use on rock crushers, tractor winches, pipe-extruding machines, drilling rigs, machine tools, pug mills and other equipment.

The three new sizes extend the time-tested, job-proved line of PO Air Clutches from 8 to 36 inches in diameter . . . in torque capacities to 126,600 pound-feet.

Check your next design . . . see for yourself how PO Air Clutches lend themselves to convenient, economical remote control. Write Twin Disc Clutch Company, Racine, Wisconsin.

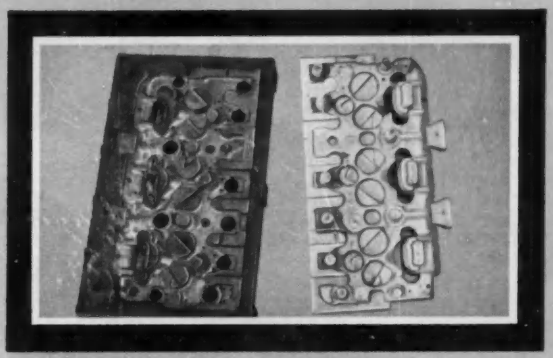
TWIN DISC

TWIN DISC

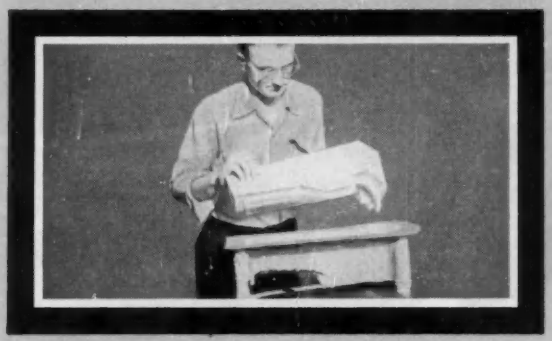
Friction Clutches and Fluid Drives

EPON® RESIN does it!

Speeds up International Harvester's Milwaukee Works' pattern modifications 65% ...cuts costs 50%!



Minimizes costs of design changes—International Harvester saved $2000 by making design modifications on an Epon resin model (right) of original drag jacket corebox (left).



Both model and mold are produced from an Epon resin-glass cloth laminate made for International Harvester's Milwaukee Works by Kish Industries, Inc., Lansing, Michigan.



Epon Resin simplifies pattern production—Epon resin faced cope and drag patterns for an IH engine can be drawn from molds with little danger of sticking.

Here's how:

AT INTERNATIONAL HARVESTER CO., world-famous manufacturers of farm equipment, Epon resins have created a money-saving revolution in foundry pattern modification.

For example: to enlarge the cross section of a frame casting for an IH crawler tractor, a pattern change would normally require 3 weeks and cost $700. *But by applying Epon resin . . . costs dropped to $300 . . . and the pattern was back in production in 1 week!*

In another situation, the use of Epon resin to make a plastic core model of a new drag jacket corebox from the old one saved IH over $2000.

In many fields of industry, the Epon resins are making such savings possible because they have ideal properties for tooling applications:

- Exceptional dimensional stability . . . high impact strength . . . excellent resistance to abrasion . . . minimum residual stress in cured parts.
- Ease and speed of preparation.
- Low shrinkage in filled formulations, assuring perfect master reproductions; minimum warping and stresses.
- Adaptability to repairs and design changes.
- Minimum finishing requirements for smooth surfaces.

Can Epon resin tools and dies make comparable improvements and savings in *your* operations? Find out now by writing your tooling resin formulator.

SHELL CHEMICAL CORPORATION

CHEMICAL SALES DIVISION, 380 Madison Avenue, New York 17, New York

Atlanta • Boston • Chicago • Cleveland • Detroit • Houston • Los Angeles • Newark • New York • San Francisco • St. Louis
IN CANADA: Chemical Division, Shell Oil Company of Canada, Limited • Montreal • Toronto • Vancouver

SHELL



bright idea

For enduring beauty that sells in a new car and re-sells in a used car . . . design it, improve it and protect it with McLOUTH STAINLESS STEEL.

specify

McLOUTH STAINLESS STEEL

HIGH QUALITY SHEET AND STRIP

for automobiles

McLOUTH STEEL CORPORATION DETROIT, MICHIGAN

MANUFACTURERS OF STAINLESS AND CARBON STEELS



Prongs snap into
punched or drilled hole

CUSTOM-DESIGNED AND MASS PRODUCED TO YOUR PARTICULAR REQUIREMENTS

Dot plug buttons were originally used in automobiles to fill spaces on standard models which, on de luxe models would be occupied by such extras as cigarette lighters, radio controls and so on. They are now also widely used as lenses for indicator lights and as identification buttons on instrument and control panels of all kinds.

Available in clear or colored plastics... brass or steel in all standard finishes... embossed and enamel-filled or molded to show company insignia or other identification symbols . . . Dot plug buttons snap into place and stay where they're put even under conditions of extreme vibration. Yet they can be removed and replaced repeatedly without damage.

CARR FASTENER COMPANY

DIVISION OF UNITED-CARR FASTENER CORPORATION 31 Ames Street, Cambridge 42, Massachusetts

MAKERS OF DOT FASTENERS

Now used by two million-car-a-year manufacturers

Sealed Power's NEW STAINLESS STEEL OIL RING



U. S. Patent No. 2,789,872

6

advantages carbon steel rings don't have

- holds full tension at engine operating temperature
- highly resistant to corrosion
- won't sludge
- side-sealing because of axial pressure of expander
- conforms independently of ring groove depth
- high radial pressure against cylinder wall assures maximum oil control

Chrome-plated steel side rails for more than double normal ring life

Let our engineers give you full details—including exceptional performance data in cars of one of America's largest builders

SEALED POWER CORPORATION • MUSKEGON, MICHIGAN • ST. JOHNS, MICHIGAN • ROCHESTER, INDIANA • STRATFORD, ONTARIO

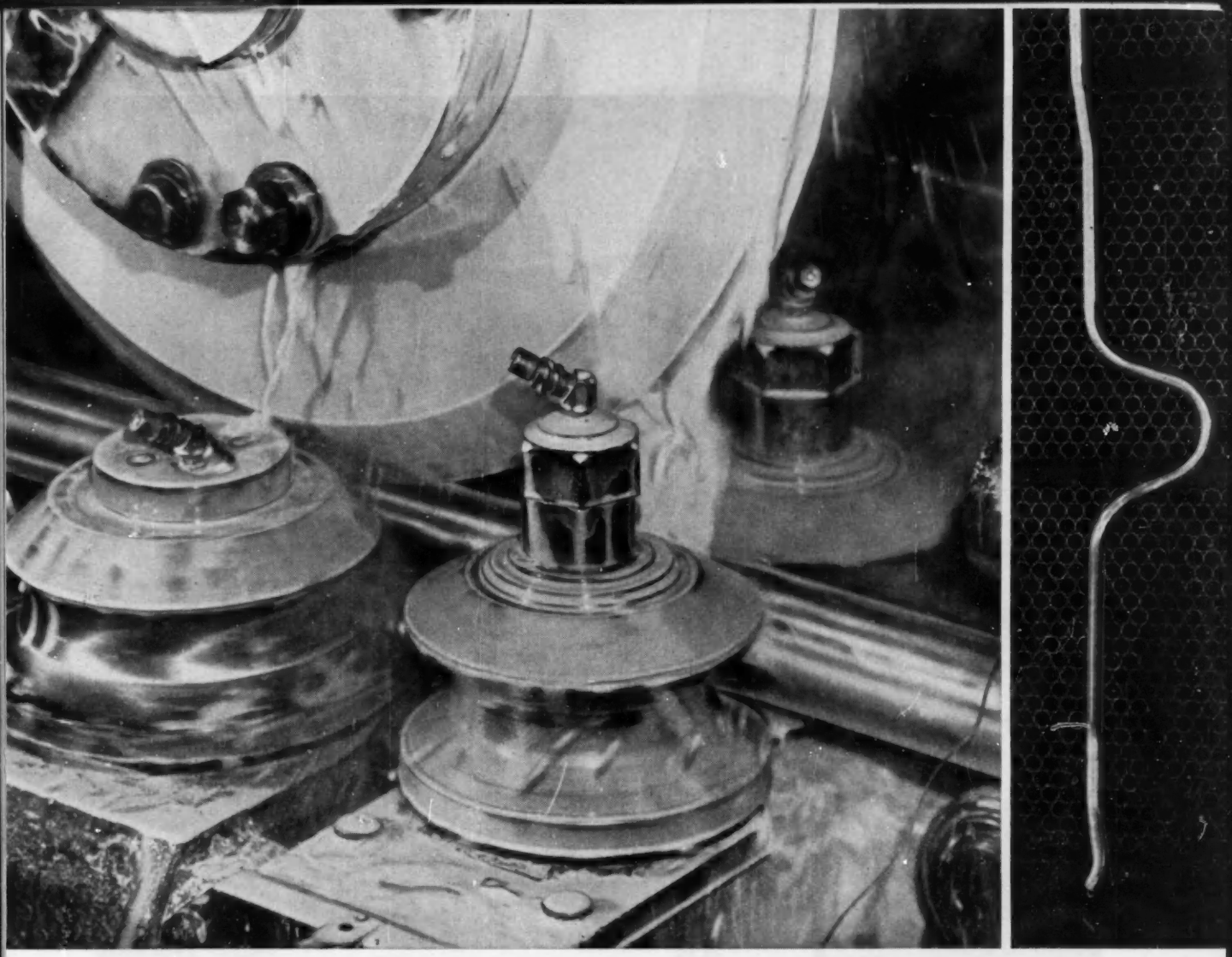
DETROIT OFFICE • 7-236 GENERAL MOTORS BUILDING • PHONE TRINITY 1-3440

Sealed Power Piston Rings

PISTONS • CYLINDER SLEEVES

Leading Manufacturer of Automotive and Industrial Piston Rings Since 1911

Largest Producers of Sealing Rings for Automatic Transmissions and Power Steering Units



Tailpipe is butt-welded (left) in a continuous seam at the rate of 150 feet per minute as it travels through a tube mill. Finished passenger car tailpipe (right) is then bent from the welded tube stock.

WELDS LIKE THIS DEMAND A UNIFORM STEEL

Automatic high-speed welding techniques, common in many industries, can work to maximum efficiency only when the steel is quality-controlled to give the best welding characteristics. Great Lakes Steel has had long experience in satisfying the exacting needs of a wide variety of customers in this respect.

Great Lakes quality-controlled steel has the uniformity of grain structure, surface and thickness that facilitates high-production welding.

But uniformity is only one of the important characteristics of Great Lakes steel. Others, such as strength and ductility, combine to bring to you dependable performance during fabrication and in the end product.

When you get Great Lakes steel you get steel that fits your specifications, delivered on time. For the full story of Great Lakes quality-controlled steel, make it a point to call your Great Lakes Steel representative soon. He's as near to you as your telephone.

GREAT LAKES STEEL CORPORATION

Detroit 29, Michigan • Division of

NATIONAL STEEL CORPORATION

District Sales Offices: Boston, Chicago, Cincinnati, Cleveland, Grand Rapids, Houston, Indianapolis, Lansing, Los Angeles, New York City, Philadelphia, Pittsburgh, Rochester, St. Louis, San Francisco, Toledo, Toronto.



Why designers specify FLEXLOC self-locking nuts

Where products must be tough . . . must stand up under vibration, shock and abuse . . . designers specify rugged, reliable, precision-built FLEXLOC self-locking nuts as fasteners.

HERE'S WHY:

FLEXLOC locknuts are strong: tensile strengths far exceed accepted standards. They are uniform: carefully manufactured to assure accurate, lasting spring tension in the flexible locking collars. And they are reusable: rough screw threads, repeated removal and replacement, frequent adjustments will not affect their locking life.

Standard FLEXLOC self-locking locknuts are available in a wide range of standard sizes and materials, to meet the most critical locknut requirements. Your authorized industrial distributor stocks them. Write us for complete catalog and technical data. Flexloc Locknut Division, STANDARD PRESSED STEEL Co., Jenkintown 55, Pa.

We also manufacture precision titanium fasteners. Write for free booklet.

FLEXLOC® LOCKNUT DIVISION

STANDARD PRESSED STEEL CO.

SPS

JENKINTOWN PENNSYLVANIA



THIS SKF

Red Seal IS YOUR BEARING INSURANCE

When ball bearings are invaded by external dirt, life is cut short. If dirt can get in, so can other contaminants... and lubricant can leak out.

But when the **SKF** Red Seal is used... dirt and moisture are repelled and lubricant is positively retained until replaced.

DuPont Fairprene, the material of the Red Seal, remains unaffected by lubricants, heat, ageing and moisture. Reinforced by a securely staked steel retaining ring, it provides maximum sealing, lightest contact, lowest friction – for the life of the bearing.

Designed for use by manufacturers of motors, portable tools, household appliances and other equipment requiring efficiently sealed bearings. Available in all standard S.A.E. widths, fully interchangeable with non-sealed bearings. 7753

EVERY TYPE—EVERY USE

SKF®

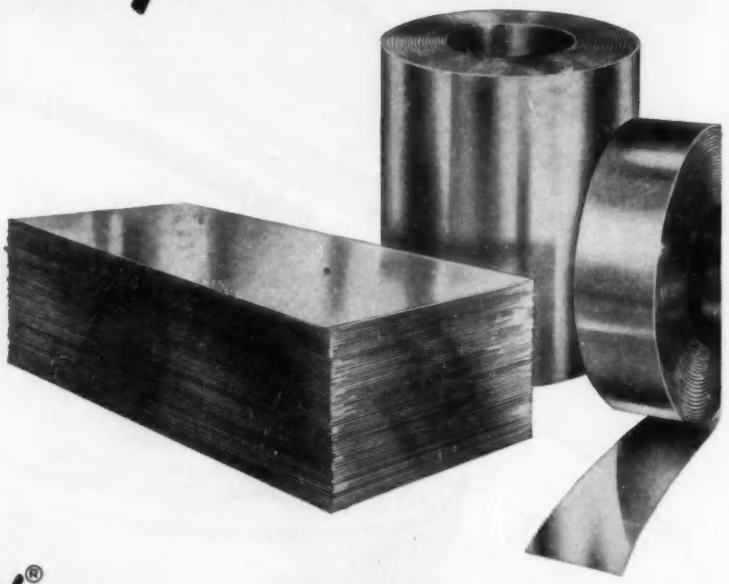
Ball Bearings
Cylindrical Roller Bearings
Spherical Roller Bearings
Tapered Roller Bearings ("Tyson")

*Reg. U.S. Pat. Off.

SKF INDUSTRIES, INC., PHILADELPHIA 32, PA.



Wherever you are you get *quick personal service*



when you order *MicroRold*® Stainless Steel Sheet & Strip

SPECIFICATIONS

	WIDTH	THICKNESS
SHEETS	up to 36″	.005 to .109
	up to 48″	.010 to .109
STRIP	up to 23 15/16″	.0015 to .090
GRADES:	201, 202, 301, 302, 304, 305, 316, 321, 347, 403, 410, 430 and Micro-Mach (special extra-high-tensile aircraft grade)	

Any one of the 305 independent steel warehouse distributors stocking MicroRold Stainless Steel is ready to serve as your *personal* stainless procurement representative. Located strategically in the U. S. A., Canada and Europe, your MicroRold distributor carries a variety of grades, widths, thicknesses and finishes and is fully qualified to assist you in the selection and fabrication of the most suitable stainless grade for your particular requirements.

Your MicroRold stainless steel distributor assures you of the fastest possible deliveries with an absolute minimum of red tape in order processing. If he is unable to fulfill your needs from stock he has available direct and immediate service from our mill. In cases of emergency, it is possible for us to roll and ship MicroRold Stainless Steel the same day the order is received.

You can rely on MicroRold service as a dependable source of supply, either mill or distributor delivery.

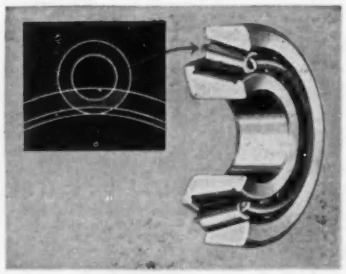
Write, wire or phone today for the name of your nearest MicroRold Stainless Steel Distributor.

WASHINGTON STEEL CORPORATION

12-K WOODLAND AVENUE WASHINGTON, PENNSYLVANIA



Tomorrow's "dream" is our job today!



HIGHER FLANGE IMPROVES ROLLER ALIGNMENT

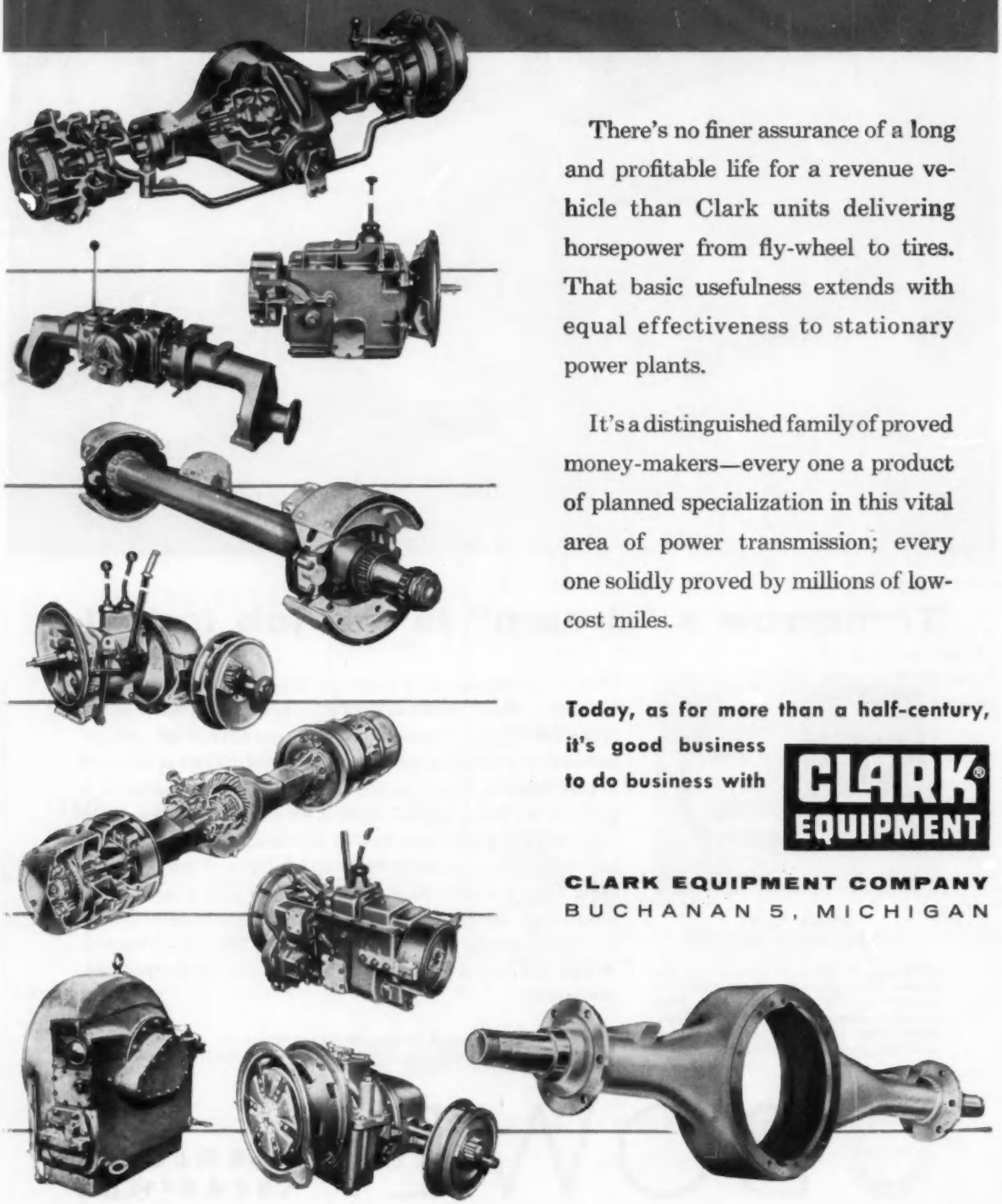
As shown by the gray area above, the higher flange provides a large two-zone contact area for the roller heads. This greatly reduces wear—practically eliminates "end play". Larger oil groove provides positive lubrication.

There's more to the car of tomorrow than just futuristic styling! Automotive engineers are working to perfect completely new power plants—like turbine engines—to achieve yet-unheard-of performance and economy! And they demand bearings that are as advanced as their thinking. This is no new challenge to Bower engineers. A glance at the design features listed at left will tell you a few of the many original Bower contributions to bearing performance which have reduced bearing maintenance and failure to a practical minimum. There are many more in the making. If your product is one which needs advanced bearings *today* plus realistic planning for the future, specify Bower. There's a complete line of tapered, straight and journal roller bearings for every field of transportation and industry.

BOWER ROLLER BEARING DIVISION
FEDERAL-MOGUL-BOWER BEARINGS, INC. • DETROIT 14, MICHIGAN

BOWER ROLLER BEARINGS

From fly-wheel to drive-wheel
. . . let it be CLARK



There's no finer assurance of a long and profitable life for a revenue vehicle than Clark units delivering horsepower from fly-wheel to tires. That basic usefulness extends with equal effectiveness to stationary power plants.

It's a distinguished family of proved money-makers—every one a product of planned specialization in this vital area of power transmission; every one solidly proved by millions of low-cost miles.

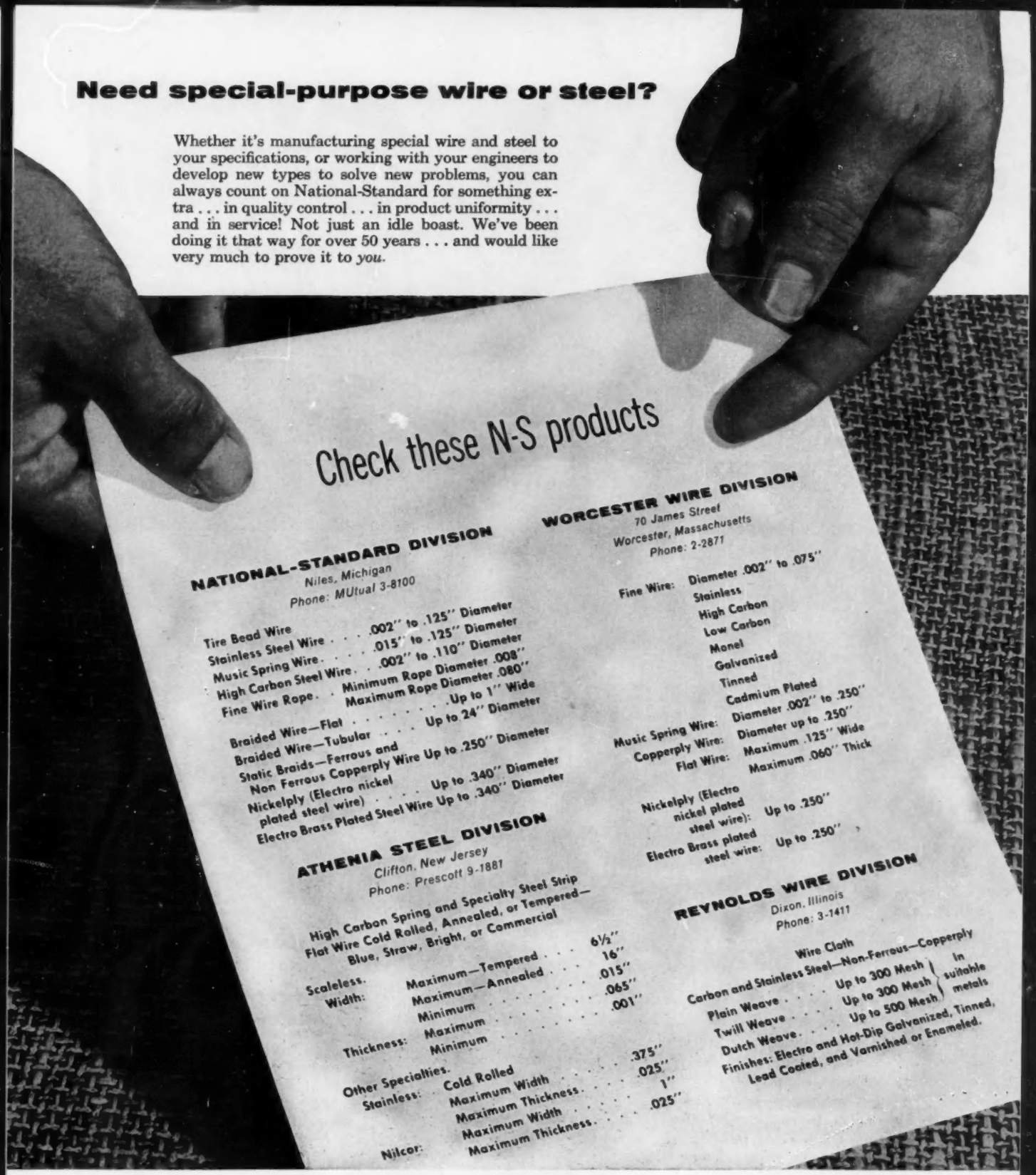
Today, as for more than a half-century, it's good business to do business with

CLARK® EQUIPMENT

CLARK EQUIPMENT COMPANY
BUCHANAN 5, MICHIGAN

Need special-purpose wire or steel?

Whether it's manufacturing special wire and steel to your specifications, or working with your engineers to develop new types to solve new problems, you can always count on National-Standard for something extra . . . in quality control . . . in product uniformity . . . and in service! Not just an idle boast. We've been doing it that way for over 50 years . . . and would like very much to prove it to *you*.



Check these N-S products

NATIONAL-STANDARD DIVISION
Niles, Michigan
Phone: MUtual 3-8100

Tire Bead Wire . . . .002" to .125" Diameter
Stainless Steel Wire . . . .015" to .125" Diameter
Music Spring Wire . . . .002" to .110" Diameter
High Carbon Steel Wire . . Minimum Rope Diameter .008"
Fine Wire Rope . . Maximum Rope Diameter .080"
Braided Wire—Flat . . . . . Up to 1" Wide
Braided Wire—Tubular . . . Up to 24" Diameter
Static Braids—Ferrous and Non Ferrous Copperply Wire Up to .250" Diameter
Nickelply (Electro nickel plated steel wire) . . . . Up to .340" Diameter
Electro Brass Plated Steel Wire Up to .340" Diameter

ATHENIA STEEL DIVISION
Clifton, New Jersey
Phone: Prescott 9-1881

High Carbon Spring and Specialty Steel Strip
Flat Wire Cold Rolled, Annealed, or Tempered—
Blue, Straw, Bright, or Commercial

Scaleless. Width: Maximum—Tempered . . . 6½"
Maximum—Annealed . . . 16"
Thickness: Minimum . . . . . .015"
Maximum . . . . . .065"
Minimum . . . . . .001"

Other Specialties.
Stainless: Cold Rolled
Maximum Width . . . . . .375"
Maximum Thickness . . . . .025"
Nilcor: Maximum Width . . . . . 1"
Maximum Thickness . . . . .025"

WORCESTER WIRE DIVISION
70 James Street
Worcester, Massachusetts
Phone: 2-2871

Fine Wire: Diameter .002" to .075"
Stainless
High Carbon
Low Carbon
Monel
Galvanized
Tinned
Cadmium Plated
Music Spring Wire: Diameter .002" to .250"
Copperply Wire: Diameter up to .250"
Flat Wire: Maximum .125" Wide
Maximum .060" Thick

Nickelply (Electro nickel plated steel wire): Up to .250"
Electro Brass plated steel wire: Up to .250"

REYNOLDS WIRE DIVISION
Dixon, Illinois
Phone: 3-1411

Wire Cloth
Carbon and Stainless Steel—Non-Ferrous—Copperply
Plain Weave . . . . Up to 300 Mesh } In
Twill Weave . . . . Up to 300 Mesh } suitable
Dutch Weave . . . . Up to 500 Mesh } metals
Finishes: Electro and Hot-Dip Galvanized, Tinned, Lead Coated, and Varnished or Enameled.

NATIONAL STANDARD

DIVISIONS: NATIONAL-STANDARD, Niles, Mich.; *tire wire, stainless, music spring and plated wires* • WORCESTER WIRE WORKS, Worcester, Mass.; *high and low carbon specialty wires*
WAGNER LITHO MACHINERY, Secaucus, N. J.; *metal decorating equipment* • ATHENIA STEEL, Clifton, N. J.; *flat, high carbon spring steels* • REYNOLDS WIRE, Dixon, Ill.; *industrial wire cloth*



STROMBERG



more than 40 years of outstanding performance

In specifying components for the automobiles they build, car manufacturers will do well to examine the record of the Stromberg* Carburetor—more than 40 years of outstanding performance. Extreme RELIABILITY and outstanding GASOLINE ECONOMY are Stromberg's distinguishing characteristics. And the record proves it. Stromberg Carburetors are designed and built by Bendix-Elmira, pioneer in fuel system engineering and the *first manufacturer* to develop an electronic fuel injection system for automobiles. Owner loyalty is the auto maker's most priceless asset. Stromberg helps build owner loyalty.

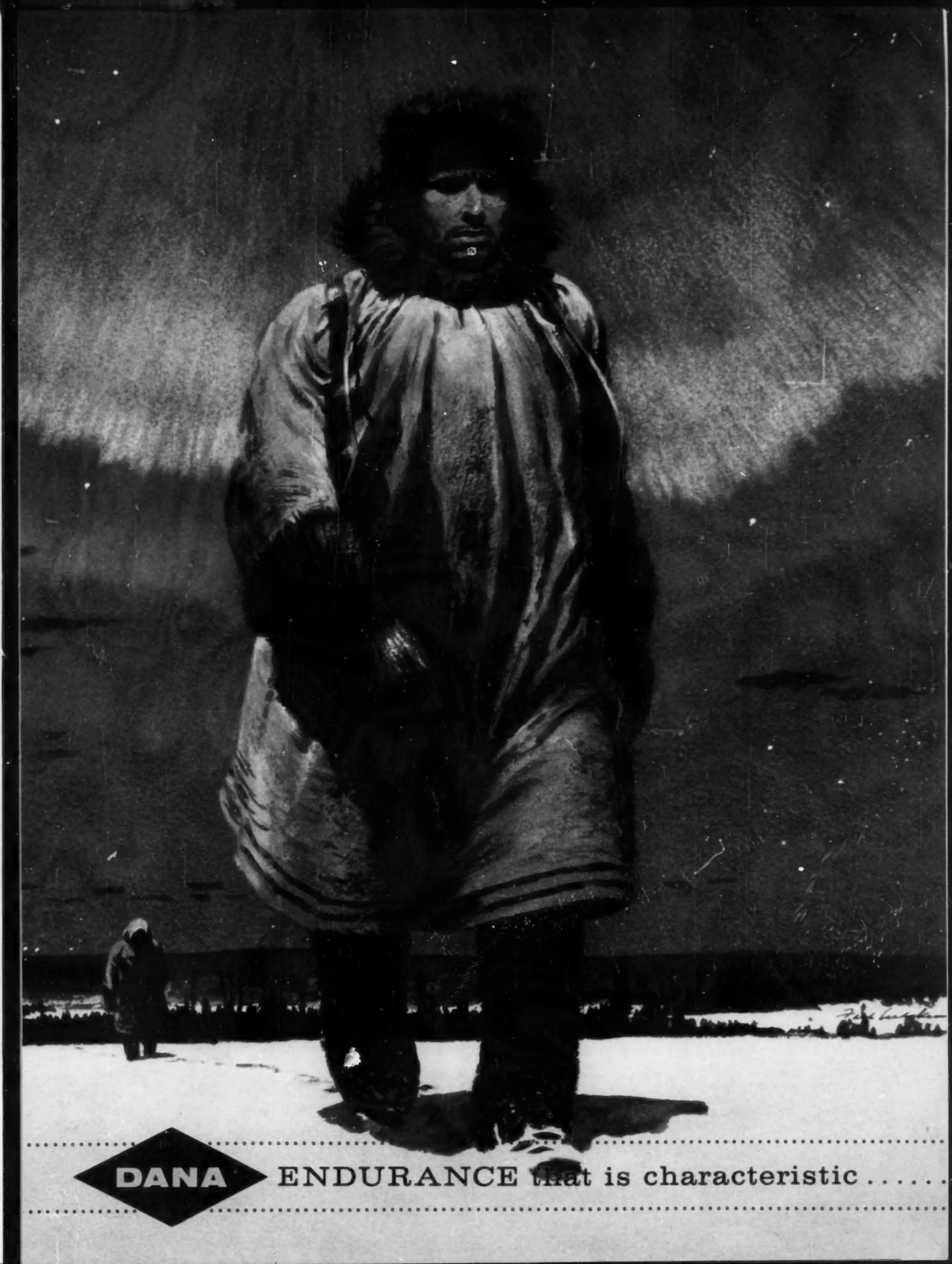
*REG. U. S. PAT. OFF.

HERE'S HOW STROMBERG OUTPERFORMS THEM ALL

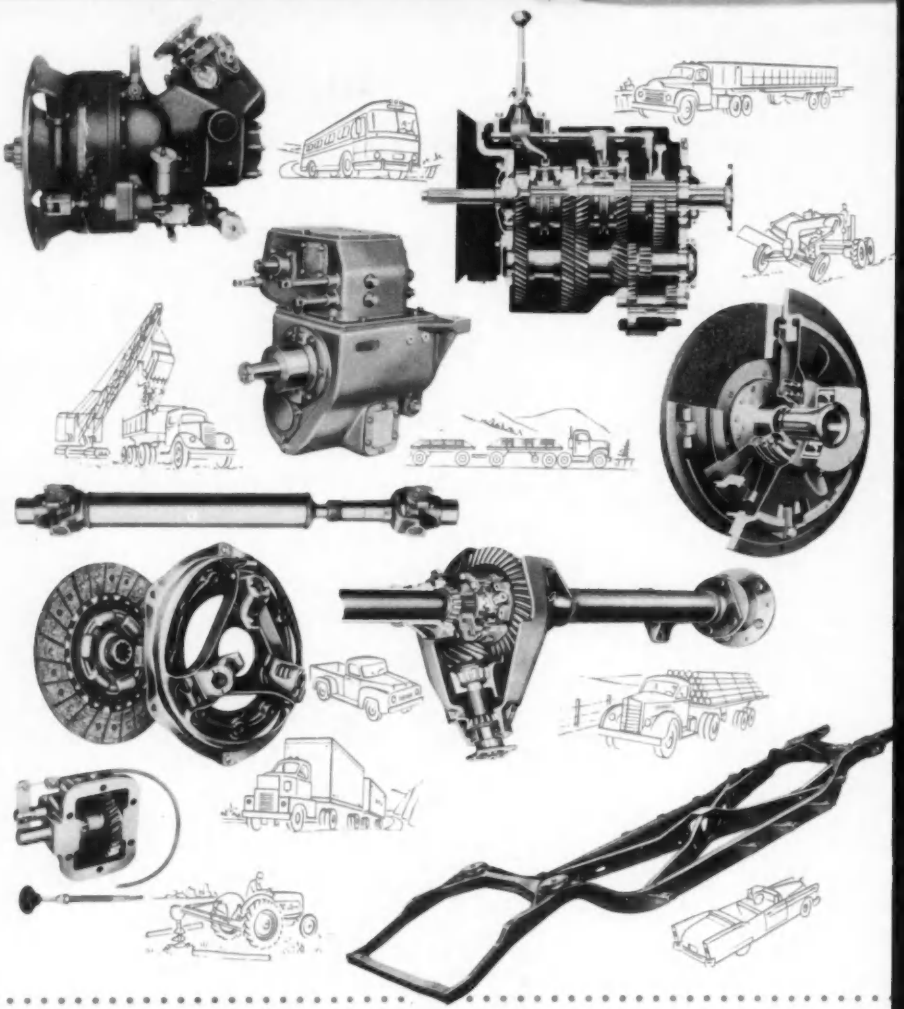
- Economical operation, more miles per gallon, happier customers
- Fewer moving parts, fewer mechanical failures, reduced service cost
- Substantially reduced incidence of icing and percolation
- Thin aluminum throttle body and flange for quicker heat transfer

Bendix-Elmira, N. Y.
ECLIPSE MACHINE DIVISION

Bendix
AVIATION CORPORATION


DANA
ENDURANCE that is characteristic . . . . .





ENDURANCE that is characteristic of all Spicer products

This is a true story, as published in TRUE, the Man's Magazine.

"Strike at Seventymile!" exclaimed Fred Schroder's partner, bursting into their cabin in Dawson, Yukon Territory, in March, 1897.

"I'll start in the morning," replied Schroder. 37 years old, 5 feet 7 inches, 160 pounds. It was 15 below when he left in the black pre-dawn. Rambling on at a steady 6 to 7 mile an hour pace, he passed Fortymile at midday, 52 miles from Dawson.

Through the afternoon and into the spectacular Arctic night he mushed without stopping . . . feet, legs, lungs and heart working steadily, automatically. He had reached that condition of equilibrium when the human system becomes a perfectly functioning engine.

At midnight the cabin lights at Seventymile broke through the trees. Schroder had trekked 120 miles on foot in the astonishing time of 19 hours . . . a superhuman feat of endurance!

Painting by Fred Ludekens, courtesy TRUE, The Man's Magazine. Copyright 1955, Fawcett Publications, Inc.

Millions and millions of automotive vehicles, airplanes, ships, trains and other types of equipment have proved the stamina of Spicer equipment, in billions of miles and service hours throughout the world.

Endurance is an inbuilt feature of all Spicer products. With 10 modern plants doing much of their processing from raw material to finished product . . . with engineering genius and manufacturing skill of the highest order . . . Dana Corporation controls and maintains quality standards that have made Spicer Products "Standard of the Industry."

DANA CORPORATION, Toledo 1, Ohio

DANA PRODUCTS Serve Many Fields:

AUTOMOTIVE: Transmissions, Universal Joints, Propeller Shafts, Axles, Powr-Lok Differentials, Torque Converters, Gear Boxes, Power Take-Offs, Power Take-Off Joints, Clutches, Frames, Forgings, Stampings.

INDUSTRIAL VEHICLES AND EQUIPMENT: Transmissions, Universal Joints, Propeller Shafts, Axles, Gear Boxes, Clutches, Forgings, Stampings.

AVIATION: Universal Joints, Propeller Shafts, Axles, Gears, Forgings, Stampings.

RAILROAD: Transmissions, Universal Joints, Propeller Shafts, Generator Drives, Rail Car Drives, Pressed Steel Parts, Traction Motor Drives, Forgings, Stampings.

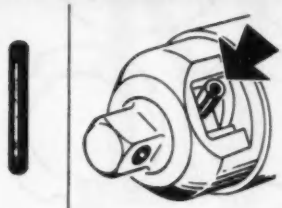
AGRICULTURE: Universal Joints, Propeller Shafts, Axles, Power Take-Offs, Power Take-Off Joints, Clutches, Forgings, Stampings.

MARINE: Universal Joints, Propeller Shafts, Gear Boxes, Forgings, Stampings.

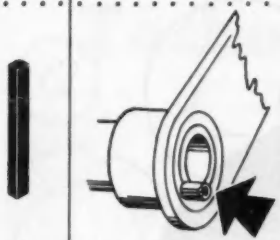
Many of these products manufactured in Canada by Hayes Steel Products Limited, Merritton, Ontario

DANA Spicer

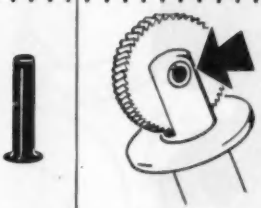
Rollpin® replaces 12 different fasteners



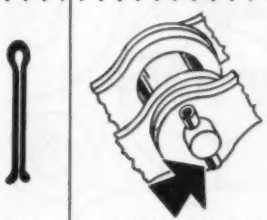
REPLACING A GROOVED PIN . . . in this application, Rollpin serves as a step pin in a ratchet wrench adaptor. With its light weight and high shear strength, Rollpin functions perfectly . . . cuts assembly costs.



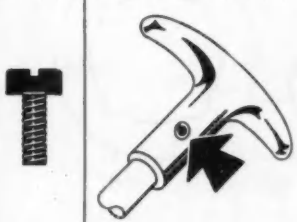
REPLACING A KEY . . . Rollpin demonstrates its ability to do away with precision tolerances, in this heating system damper arm. Faster, cheaper and more satisfactory than previous assemblies.



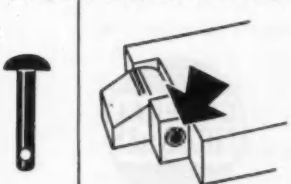
REPLACING A RIVET SHAFT . . . Rollpin serves as an axle for the sparkwheel of a cigarette lighter. No riveting or threading necessary . . . faster assembly. Note flush, clean fit.



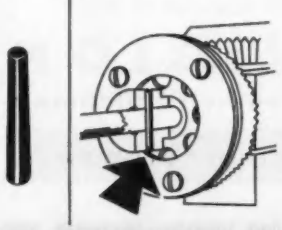
REPLACING A COTTER PIN . . . Rollpin assembly time is shorter, service life ten times longer. Vibration-proof flush fit. Easily removable.



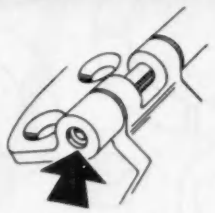
REPLACING A SET SCREW . . . to fasten automobile brake handle a short length Rollpin is self-retained in the hand grip but can easily be driven into over-drilled hole in shaft for simple handle removal.



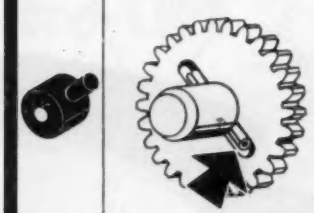
REPLACING A CLEVIS PIN . . . here Rollpin holds firmly in clevis, permits free action of moving member. Rollpin application shown is the plate of a home workshop tool.



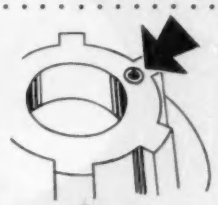
REPLACING TAPER PINS . . . in the assembly of precision differentials eliminated cost of taper pin reamers and the entire reaming operation. Rollpin costs less than a taper pin and installation is cheaper. They remove easily.



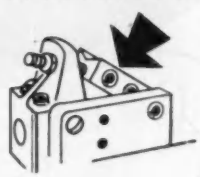
REPLACING A HEADED PIN . . . in this hinge pin application, Rollpin is simply and inexpensively driven in place, greatly reducing assembly costs. Constant spring tension holds Rollpin firmly in place . . . eliminates loosening of hinge due to wear.



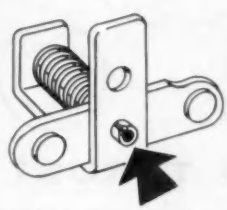
REPLACING A HUB ON A GEAR . . . Rollpin, self-retained in shaft, is simply snapped into molded slot to position sintered gear. This application, by an office equipment manufacturer, effects major savings in assembly. Rollpin's high shear strength is particularly valuable here.



REPLACING A DOWEL PIN . . . Rollpin is used here to prevent rotation of a thrust bearing. No reaming, no special locking. Easily removed. Lowest possible dowel pin cost.

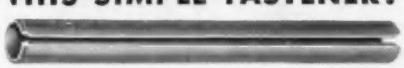


REPLACING A BOLT AND NUT . . . Rollpins act as fasteners and pivots for the linkages in this electric welder. Rollpins may be used with a free fit in outer or inner members depending upon product design requirements.



REPLACING A RIVET . . . Rollpin serves as guide shaft for spring-loaded electrical interlock contacts. This electrical equipment manufacturer reports that rivet failure previously occurred at the clinched end under normal operating impact and vibration.

WHERE CAN YOU USE THIS SIMPLE FASTENER?

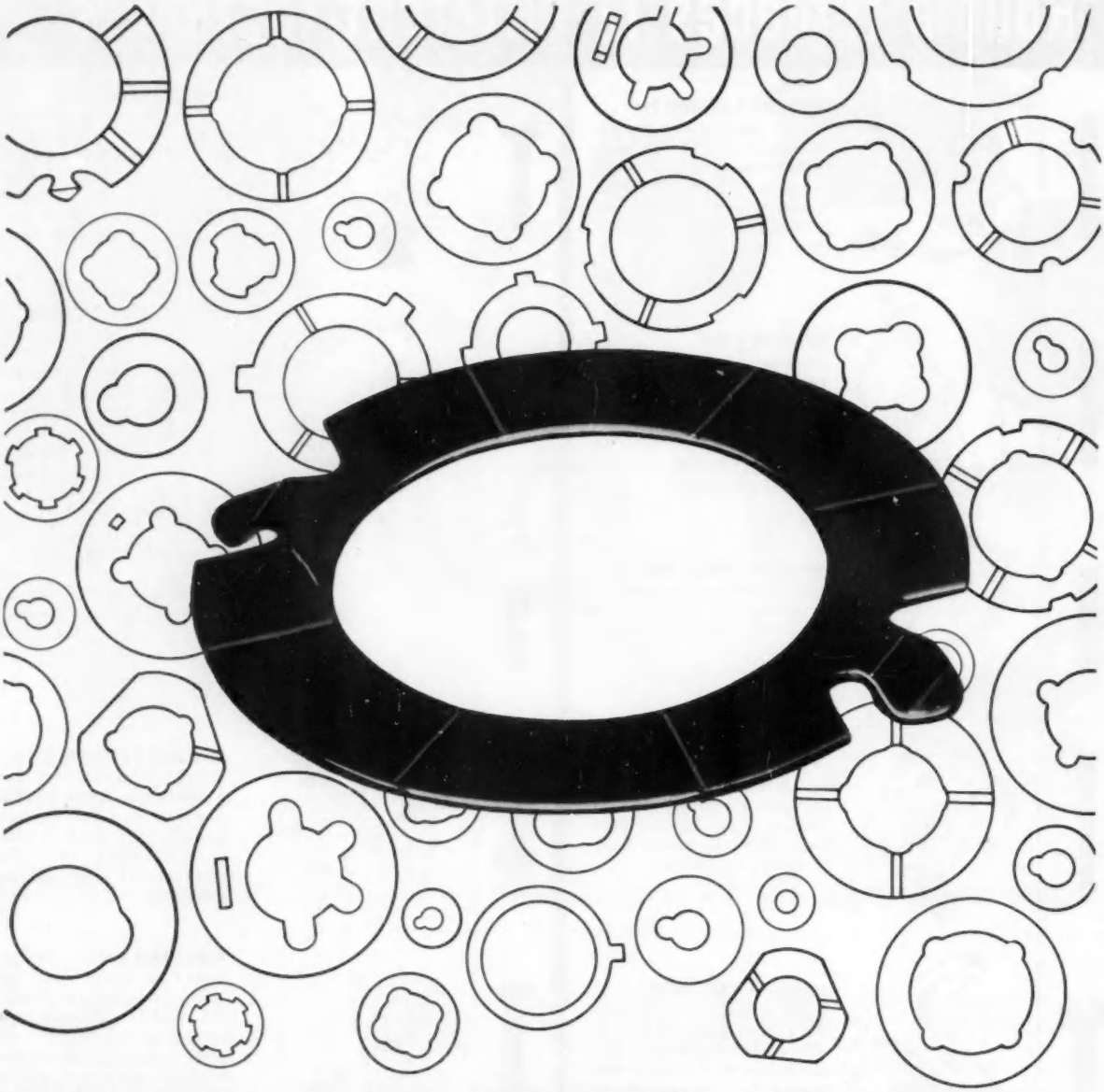


Rollpin is the slotted tubular steel pin with chamfered ends that is cutting production and maintenance costs in every class of industry.

Drives easily into standard holes, compressing as driven. Spring action locks it in place—regardless of impact loading, stress reversals or severe vibration. Rollpin is readily removable and can be re-used in the same hole. Made in carbon steel, stainless steel and beryllium copper. Write for samples and information, ELASTIC STOP NUT CORPORATION OF AMERICA, 2330 Vauxhall Road, Dept. B47-1275 Union, New Jersey.

ROLLPIN TRADEMARK

ELASTIC STOP NUT CORPORATION OF AMERICA
2330 VAUXHALL ROAD, UNION, NEW JERSEY



PRECISION THRUST WASHERS

with design flexibility and manufacturing economy

The method of manufacture permits flexibility for money-saving design features. They can be plain bronze, or steel with bronze on one or both faces, in flat, spherical or special shapes. Coining of special lubrication grooves, for example, saves on costly machining. Holes, nibs, lugs or scallops are incorporated, as desired. They are cold rolled for exceptional hardness in heavy-duty operation. Used in automatic transmissions and similar bearing applications. From 1″ to 6″ O.D. We have large capacity and provide complete engineering service.

FEDERAL Mogul SINCE 1899

FEDERAL-MOGUL DIVISION

FEDERAL-MOGUL-BOWER BEARINGS, INC., 11035 SHOEMAKER, DETROIT 13, MICHIGAN

RESEARCH • DESIGN • METALLURGY • PRECISION MANUFACTURING

NEW

Tachometer Take-Off



...for VEEDER-ROOT Rev-Counters

With this new attachment, Veeder-Root Rev-Counters can be installed on any engine having a tachometer take-off in a position which is readily accessible for easy reading. Take-off can be furnished to suit average engine-speed.

So now you can make it easier than ever for your customers to see that your product is performing up to its guarantee . . . to see when routine maintenance is coming due, and whether servicing is needed.

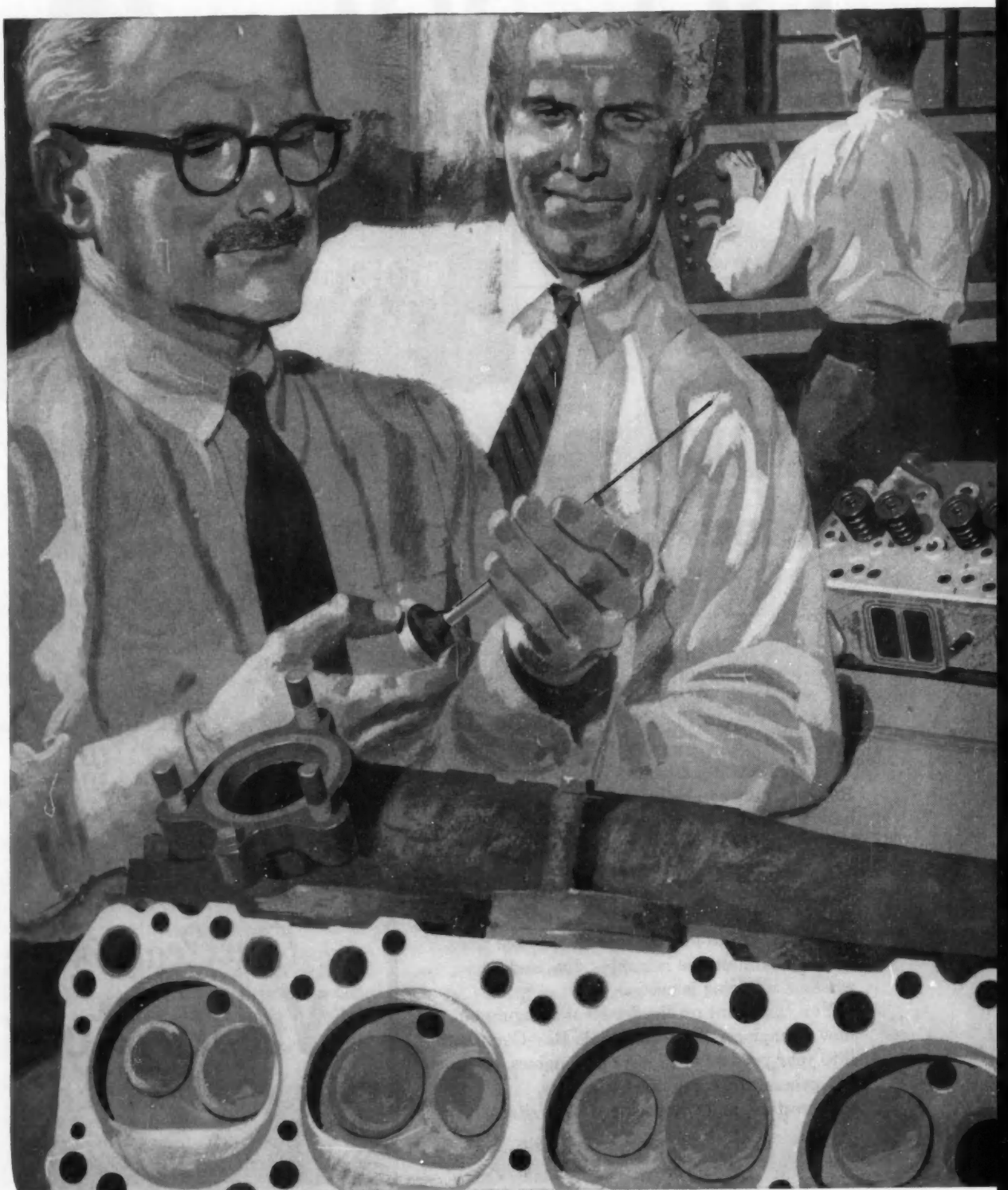
You can count on Veeder-Root to figure out how to engineer these adaptable Rev-Counters into *your* products . . . not only engines, but generators, compressors, heaters, refrigerators, and what have you? Write:

Everyone... Can Count on

VEEDER-ROOT
INCORPORATED
HARTFORD 2
CONNECTICUT

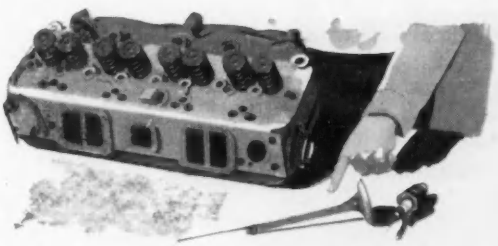
New York 19, N. Y.
Greenville, S. C. • Chicago 6, Ill.
Montreal 2, Canada
Offices and Agents in Principal Cities

"We boosted exhaust valve life



four times with aluminum heads!"

Tests run in the Alcoa Development Division Laboratories on production engines prove the advantages of aluminum heads. In one test, to determine exhaust valve temperatures accurately, Alcoa engineers actually buried thermocouples in the valve heads. In the aluminum head, exhaust valves ran an average of 100°F cooler at 3,000 rpm and 125°F cooler at 4,000 rpm than in an iron head of identical design and compression ratio. Actual production experience has proved that the cooler running valves in the aluminum head lasted four times longer.



Test valve with thermocouple in place.

Savings in gasoline

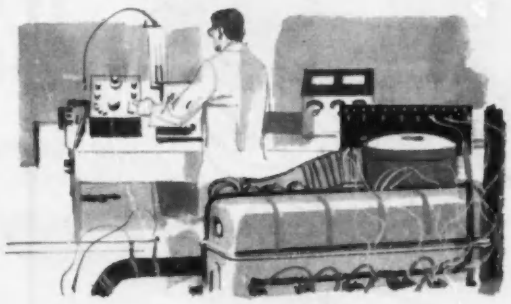
The cast iron head required fuel up to four octane numbers higher than the aluminum head. Refiners must spend millions to raise octane numbers just one point. This benefit of aluminum heads helps keep automobile operating costs down.

Savings in weight

The weight of the aluminum head in the Alcoa Development Division tests was only 40 per cent that of the cast iron head of similar design. Using aluminum heads, this saving in weight on the front end helps in correcting mal-distribution of vehicle weight, thus improving roadability and handling. With a lighter engine, there can also be a corresponding reduction in the size, weight and cost of supporting members such as suspension parts and engine mounts.

Surface ignition

As compression ratios go up in modern engines, surface ignition becomes more of a problem. It may be caused by a hot plug tip, exhaust valve or glowing piece of carbon in the combustion chamber. Aluminum heads help relieve the surface ignition problem through superior head dissipation.



Aluminum heads were run hundreds of hours in the Alcoa Laboratory.

No hot spots

Heat is more evenly distributed throughout an aluminum head. Efficient cooling is obtained in critical locations. Hot spots are eliminated. This results in lower levels of thermal distortion and a reduction in the tendency to distort. Reduced temperature ranges facilitate matching the right spark plug to the engine. Also, there is better conduction of heat away from the plugs.

Let Alcoa help

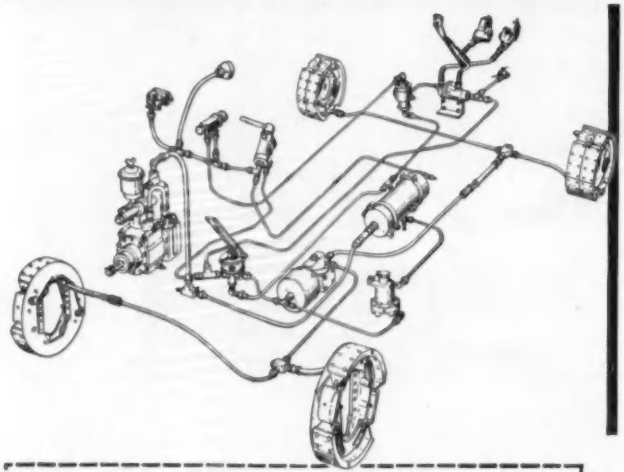
You are probably doing development work on aluminum heads right now. Alcoa, the most experienced aluminum producer in the industry, stands ready to offer the facilities of its laboratories and the knowledge of its engineers to manufacturers working on this or any other aluminum application. Let us work with you. Write Aluminum Company of America, 1844-M Alcoa Bldg., Pittsburgh 19, Pennsylvania.



NEW! "ALCOA THEATRE"
Exciting Adventure, Alternate Monday Evenings

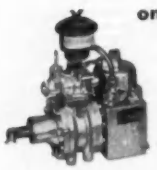
ALCOA ALUMINUM gives every car more **GLEAM AND GO**

Wagner AIR-OVER-HYDRAULIC BRAKES increase payload capacity and offer these six important operating advantages!



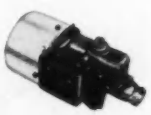
- Faster application and release of air pressure
- More efficient use of compressed air
- Greater stopping power
- Reduced friction loss
- Increased lining and drum life
- Greater stability with less preventive maintenance.

only Wagner offers...



THE ROTARY AIR COMPRESSOR

9 or 12 c.f.m. capacity—rotary motion reduces vibration, makes friction loss low, operating efficiency high, assures long life with a minimum of maintenance. Fast air recovery assures an adequate supply of air pressure at all times—an important safety factor . . . Compactly built.



THE POWER CLUSTER

converts 100 p.s.i. of air pressure into 1500 p.s.i. of unvarying hydraulic pressure for greater road safety and surer stopping power. Consists of an air-power cylinder assembled direct to a standard hydraulic master cylinder. No loss due to linkage or friction.

Wagner Air-Over-Hydraulic systems are designed to eliminate bulky, heavy, out-board rigged actuating devices and many valves and lines to permit greater pay load capacity through vehicle net weight reduction. These actuating systems also offer finer performance features for safer braking of heavy vehicles equipped with hydraulic foundation brakes.

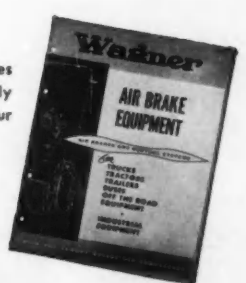
But get the whole story on Wagner Air-Over-Hydraulic Air Brakes for yourself—*first* in economy, reliability and maximum brake safety. Send for Catalog KU-201 that describes the performance and safety features you add to the trucks you manufacture by equipping them with Wagner Air Brakes.

K57-10

Wagner Electric Corporation

6378 PLYMOUTH AVENUE, ST. LOUIS 14, MO., U. S. A.

The complete Wagner Air Brake Line includes many types and kinds of equipment—all fully described in Catalog KU-201. Write for your copy today.



LOCKHEED HYDRAULIC BRAKE PARTS and FLUID • NoRoL • CoMaX BRAKE LINING • AIR BRAKES • AIR HORNS • TACHOGRAPHS • ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES

for New Ideas in safety, comfort and simplified production

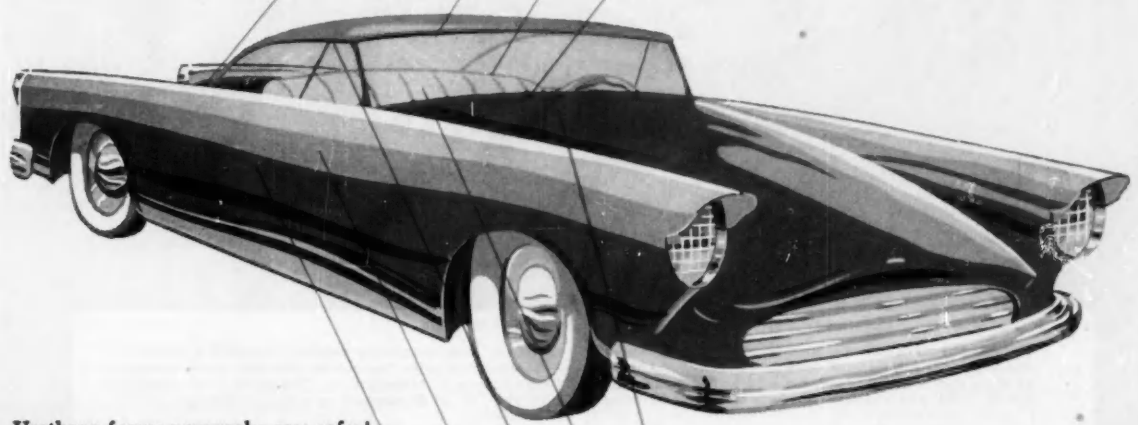
Investigate URETHANES!

Foamed-in-place "cushioned trunk lining" to protect luggage can add a new sales point.

Sun visors are also padded. Urethane headlining insulates against sun and cold while thicker foam up forward gives added safety-pad protection.

Rear-seat passengers are protected with safety-padding behind front seat. Low cost and light weight encourage generous use of urethanes.

Safety-padded dash has optimum resilience, absorbs shock without dangerous "bounce-back".



Rigid foam can be used to insulate against motor heat and to water-seal wiring and cables.

Controlled resilience gives the proper degree of buoyancy so urethanes can be used in seat cushions.

Urethane door-seals and weather-stripping around windows resist deterioration.

Arm rests are easily made by foaming urethane to the supporting insert and the outer covering in one simultaneous operation.

Luxurious "sculptured" door panels can be made by foaming urethane to the outer coverings in an embossed mold.

Urethane foams now make cars safer!

Soon, they may also be widely used to make cars more comfortable . . . to keep out heat and cold . . . to deaden road noise . . . and to add new notes of interior luxury.

Made with National Nacconates®, urethane foams are easy and economical to use. They can be cut and sewn, tacked, die-cut, sawed, molded to required shapes . . . or foamed in place. They are readily bonded to or sandwiched between fabrics, plastics or other construction materials.

Additionally, urethane rigid foams and urethane coatings have exciting possibilities in trucks, trailers and other automotive applications.

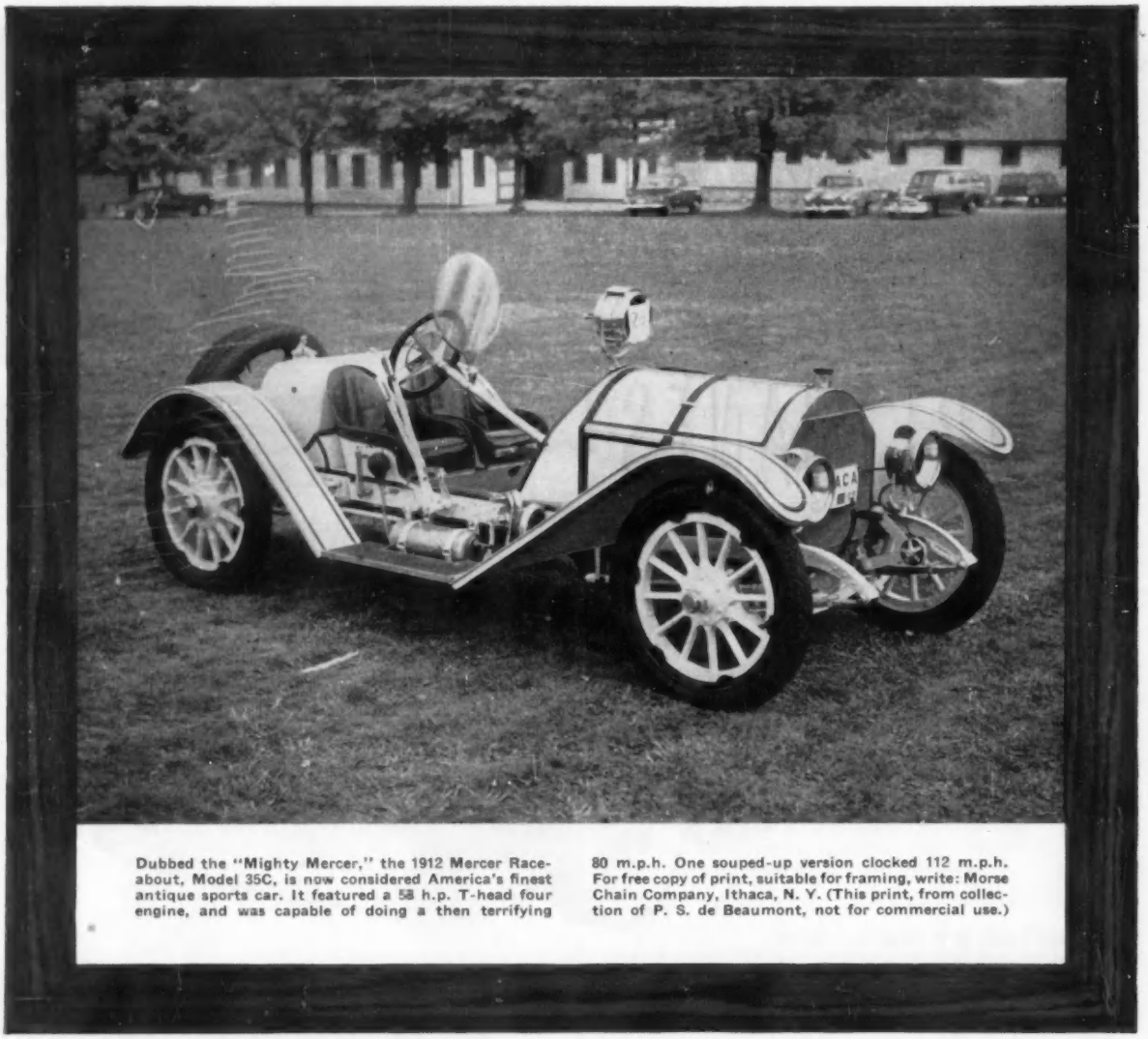
For additional information, write National Aniline describing as fully as possible your potential use.

National Aniline does not make urethanes but is a major producer of diisocyanates-Nacconates®—basic component of all urethane formulations.

NATIONAL ANILINE DIVISION
ALLIED CHEMICAL & DYE CORPORATION
40 RECTOR STREET, NEW YORK 6, N. Y.

Akron Atlanta Boston Charlotte Chattanooga Chicago
Columbus, Ga. Greensboro Los Angeles New Orleans Philadelphia
Portland, Ore. Providence Richmond San Francisco Toronto

National Aniline Allied Chemical



Dubbed the "Mighty Mercer," the 1912 Mercer Raceabout, Model 35C, is now considered America's finest antique sports car. It featured a 58 h.p. T-head four engine, and was capable of doing a then terrifying 80 m.p.h. One souped-up version clocked 112 m.p.h. For free copy of print, suitable for framing, write: Morse Chain Company, Ithaca, N. Y. (This print, from collection of P. S. de Beaumont, not for commercial use.)

OVER 80,000,000 MORSE TIMING CHAINS INSURE LONG SERVICE LIFE OF CARS, TRUCKS, AND BUSES

Matter of fact, 21 out of 23 cars specify Morse Timing Chains as original equipment.

The reason for this overwhelming acceptance is easy to understand: Morse Timing Chain Drives are precision-built—like fine watches—to give car, truck, and bus owners long service life and freedom from maintenance worries.

If you have a timing chain problem, get in touch with Morse for practical engineering help and fast service.

For more information, phone, wire or write: *MORSE CHAIN COMPANY, DETROIT, MICHIGAN; ITHACA, NEW YORK. Export Sales: Borg-Warner International, Chicago 3, Ill.*

SERVING THE AUTOMOTIVE INDUSTRY FOR OVER 55 YEARS

MORSE MORSE BW

*Trademark

USING

DU PONT ELASTOMERS

neoprene · Hypalon®



in design

New neoprene hinge cuts installation time on bus door from one hour to 15 minutes

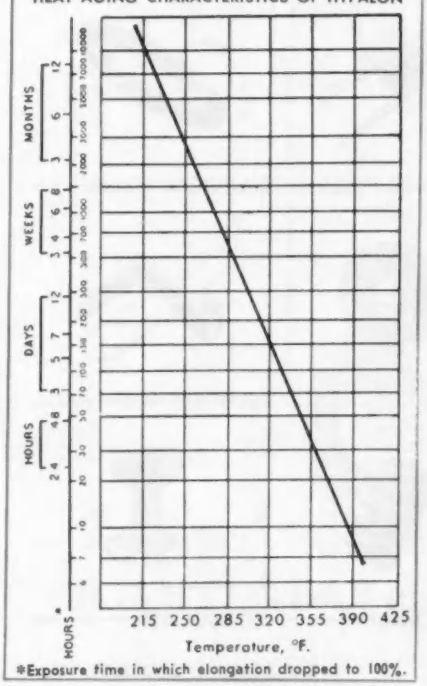
Parts of HYPALON have exceptional heat resistance

Compared with other kinds of rubber, HYPALON shows unusual resistance to hardening at elevated temperatures (250°-350° F.). This means an extra-long service life for belts, hose, gaskets and other parts exposed to engine heat.

The graph below indicates heat aging characteristics of HYPALON. It shows, for example, that compounds of HYPALON will retain 100% elongation after three weeks' *continuous* exposure at 285° F., three months at 250° F. and almost a year at 212° F. Longer service life can naturally be expected where temperatures are intermittent.

Other advantages of HYPALON that are useful in automotive design include its outstanding resistance to sunlight and weather and complete ozone resistance. HYPALON, Du Pont's newest synthetic rubber, can also be made in a variety of light-stable colors. Mail coupon for more details.

HEAT AGING CHARACTERISTICS OF HYPALON



*Exposure time in which elongation dropped to 100%.

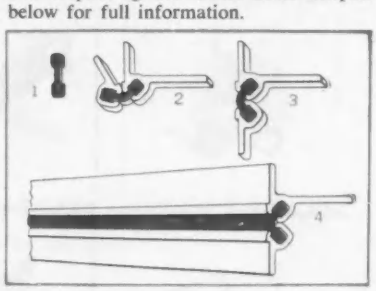


Neoprene hinge permits door replacement in 15 minutes. Only 2 pins are required to hold the door securely.

A new neoprene baggage door hinge has been developed by a coach manufacturer to replace metal piano hinges which required 80 rivets per door for installation. With 6 to 10 doors per coach, savings in time and labor costs have been significant. Where installation of piano hinges involved one hour per door, the neoprene hinge is installed in 15 minutes. Two pins drilled into the neoprene strip are all that's required to secure the door after it has been slipped over the hinge.

Neoprene was the logical choice for the hinge because of its exceptional resistance to aging and flex cracking. In laboratory tests, it withstood 1½ million flexing cycles without damage. In service, neoprene withstands the deteriorating effects of sun and weather, ozone and oxidation. Under tension at all times, the neoprene hinge also serves as a seal to keep the elements out of the baggage compartment.

Neoprene's balanced combination of properties makes it practical for a variety of automotive uses. Hose, gaskets and flexible couplings are just a few. This Du Pont synthetic rubber offers many other opportunities for designing new products and improving old ones. Mail coupon below for full information.



1. Hinge **2.** Hinge open **3.** Hinge closed
4. Hinge makes moisture-tight seal open or closed.

DU PONT

HYPALON *is a registered trademark of E. I. du Pont de Nemours & Co. (Inc.)*

BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY



☐ I am particularly interested in _____

☐ Send me a free copy of *The Du Pont Elastomers* (a review of properties of neoprene and HYPALON).

☐ Add my name to the free mailing list of the *Elastomers Notebook* (contains articles based on uses of Du Pont elastomers in industry).

E. I. du Pont de Nemours & Co. (Inc.)
Elastomer Chemicals Dept. SAE-12
Wilmington 98, Delaware

Name _____ Position _____

Firm _____

Address _____

City _____ State _____



ENDLESS APPLICATIONS

spri


ASSEMBLIES


BARREL


BELLEVILLE


BELT


BRACELET


CATCHES


CLAMPS

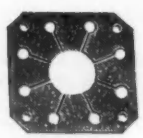

CLIPS


CLOCK


COLLARS


COMPRESSION


CONICAL


DIAPHRAGM


DIE


DISCS


DOUBLE TORSION


DRAWBAR


EXTENSION


ELECTRONIC COILS


ELLIPTICAL


FASTENERS


FLAT


GARTER


HAIRSPRINGS


HANGERS


HELICAL


HOLDERS


HOOKS


HOT-WOUND


HOURGLASS

THOUSANDS OF VARIATIONS

ngs

(AND OTHER THINGS)

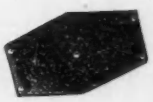
with the leading engineering and production skills to tailor them to your mechanisms



LATCHING



LOCKING



PLATES



POWER



RETAINERS



RINGS



SPIRAL



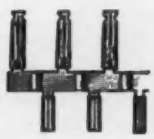
STAMPINGS



STARTER



SWIVEL END



TERMINALS



TORSION



VALVE



VARIABLE PITCH



VOLUTE



WASHERS

Send for "Picture Book of Springs"—shows many more examples



WIRE FORMS

5702
© 1957 A.S.C.
BRISTOL, CONN., U.S.A.



Divisions of

ASSOCIATED SPRING CORPORATION

GENERAL OFFICES: BRISTOL, CONNECTICUT



Large Part...Small Part ...in Natural or Synthetic Rubber...



PHOENIX **4-STEP SERVICE**

ASSURES A BETTER END PRODUCT

Phoenix 4-Step Service can be of invaluable assistance in helping you utilize rubber to develop a better end product. Compounding and fabricating rubber has been a Phoenix specialty for 25 years. This concentration enables Phoenix to develop natural and synthetic rubber compounds to solve a variety of product design problems involving such factors as high and low temperature, abrasion, weather, load, torque, corrosive fluids and bonding to other materials. You can confidently put *your* rubber problem to Phoenix for an imaginative and thoroughly satisfactory solution!

Leading Manufacturers of Custom Molded Mechanical Rubber



STEP 1—ANALYSIS Phoenix studies the part to determine which will be the most suitable rubber compound.



STEP 2—DESIGN Phoenix assists in designing the part to perform the function intended at an acceptable cost.



STEP 3—COMPOUNDING Then Phoenix compounds and tests the most suitable natural or synthetic rubber.



STEP 4—MANUFACTURE Modern equipment and exacting production control assure fast, accurate molding.

PHOENIX

RUBBER PRODUCTS DIVISION
PHOENIX MANUFACTURING COMPANY
JOLIET, ILL. • FOUNDED 1882

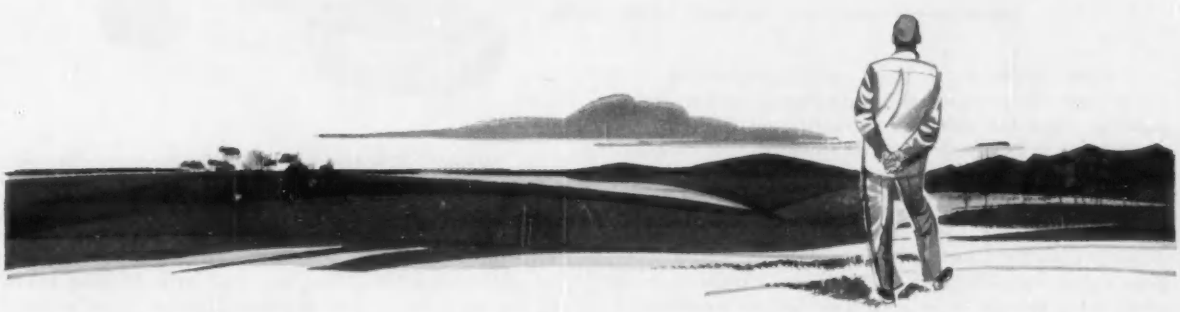
Integrated Manufacturing Facilities: RUBBER PRODUCTS DIVISION, FLANGE AND FORGING DIVISION, STEEL MILL DIVISION, STEEL BUILDING PRODUCTS DIVISION, HORSESHOE PRODUCTS DIVISION

Engineering the future today: world peace

The desire for unity,
the wish for peace,
the longing for concord,
deeply implanted
in the human heart,

have stirred
some of the most
powerful emotions of the race,
and have been responsible
for some of its noblest actions.

—*Sir William Osler*



CARTER CARBURETOR

Division of ACF INDUSTRIES, INCORPORATED • St. Louis 7, Missouri

There's no substitute for the FORGED crankshaft



Crankshaft forgings illustrated, left to right, for V-8 passenger car, diesel truck and heavy tractor engines

Crankshafts have been made successfully by other methods of fabrication and have proven to be *good enough* for certain non-critical applications — but for maximum dependability of the modern, compact, high compression, high torque engine a forged crankshaft is essential.

The forging process assures, to the greatest degree possible, uniformity and predictability of physical properties with a minimum variance from piece to piece or from one location to another in the same piece.

Wyman-Gordon has been forging crankshafts since the beginning of the internal combustion engine era and today produces more crankshafts for a greater variety of applications than any other company in the world. In a crankshaft there is no substitute for a forging, and in a forging there is no substitute for Wyman-Gordon quality and experience.

WYMAN-GORDON COMPANY

Established 1883

WORCESTER 1, MASSACHUSETTS
HARVEY, ILLINOIS • DETROIT, MICHIGAN

FORGINGS OF ALUMINUM • MAGNESIUM • STEEL • TITANIUM



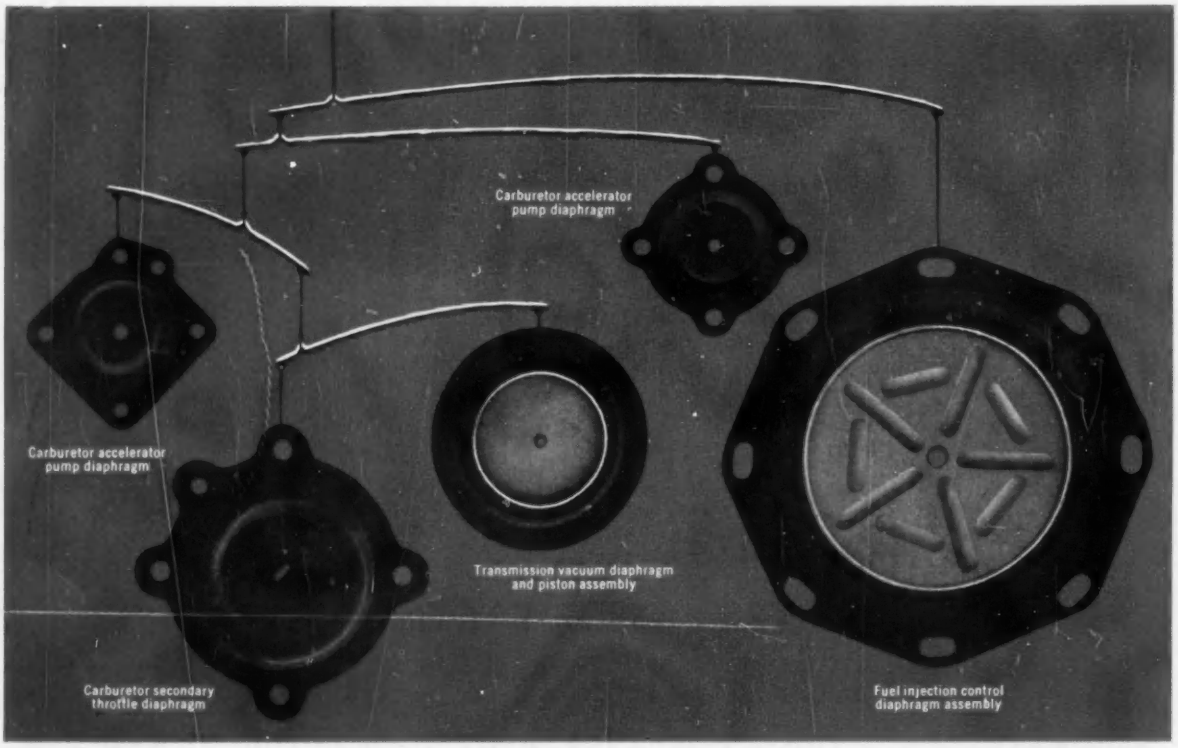
NEW ZINC I.D. TUBING RESISTS CORROSION— RETAINS OUTSTANDING STRENGTH, DUCTILITY AND *ECONOMY* OF STEEL!

You can now use economical steel tubing for applications formerly restricted to more expensive materials. Through an exclusive and inexpensive process, GM Steel Tubing makes available tubing that withstands corrosion and yet retains the important strength and economy of steel.

Outstanding new GM Steel Tubing with Zinc I.D. has a corrosion-resistant metallic coating which is non-porous, uniform in thickness and sufficiently ductile for manufacturing operations. The coating does not yield a volume build-up of corrosion deposits. The tubing is completely annealed and the coating entirely intact when delivered. Investigate the immediate savings possible with GM Steel Tubing with Zinc I.D. Write direct or call your GM Sales Engineer. And watch for important tubing advances of the future to take shape at GM Steel Tubing.

GM STEEL TUBING by ROCHESTER PRODUCTS

ROCHESTER PRODUCTS DIVISION OF GENERAL MOTORS, ROCHESTER, N. Y.



Need Critical Diaphragms?

C/R will design, compound and mold them to your exact specifications

Simple or complex, your diaphragm problem can be solved quickly, dependably with the help of C/R Sirvene engineers. Their specialized experience gained in the solution of hundreds of similar problems is yours to use. They will design and compound the correct elastomers to produce the exact degree of hardness, tensile strength, compression set, volume change and flexibility you require. Temperature resistance, with various materials, ranges from —100° to 500°F., and compatibility with an equally broad range of fluids, gases and solids, including petroleum base fuels and synthetic hydraulic oils can easily be achieved.

Whether you specify critical tolerances, exact concentricity or flawless bonding—the more reason to assign full responsibility to C/R Sirvene engineers. They'll assure the absolute uniformity and quality of your diaphragm straight through production. Define your diaphragm problem to us and see how we can help.



Write for your copy of the illustrated Diaphragm Bulletin SD-100.

CHICAGO RAWHIDE MANUFACTURING COMPANY
1243 ELSTON AVENUE • CHICAGO 22, ILLINOIS
Offices in 55 principal cities. See your telephone book.
In Canada: Manufactured and Distributed by Chicago Rawhide Mfg. Co. of Canada, Ltd. Hamilton, Ontario. **Export Sales:** Gean International Corp., Great Neck, New York.
Other C/R Products: *C/R Shaft and End Face Seals • Sirvis-Conpor mechanical leather cups, packings, boots • C/R Non-metallic Gears*

SIRVENE C/R DIVISION
CHICAGO RAWHIDE

you can meet any lubrication specification if you

BLEND WITH ENJAY PARANOX®

(DETERGENT-INHIBITOR ADDITIVES)

Blended with Paranox, lubricants can be compounded to combine *both* minimum wear and maximum engine cleanliness characteristics. That's why more and more refiners and blenders are relying *exclusively* on Paranox in formulating lubricants for heavy duty equipment and all engines that are subjected to tough operating conditions.

Through years of intensive research and development work with manufacturers and oil companies, Enjay has developed the only *complete line* of high quality additives (Paramins®) that can assure *maximum* performance characteristics. Why not let this experience and know-how work for *you*? Contact the Enjay Company today.

ENJAY

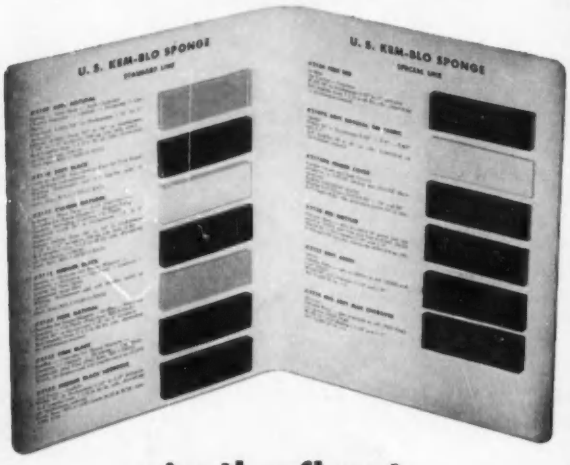
Pioneer in Petrochemicals

ENJAY COMPANY, INC., 15 WEST 51st ST., NEW YORK 19, N. Y.

Akron • Boston • Chicago • Detroit • Los Angeles • New Orleans • Tulsa



Send for your Handy Guide



to the finest in Sponge Rubber today!



For your ready reference—13 different actual Kem-Blo swatches included in this handy, file-fitting folder

U. S. Kem-Blo is a light... flexible... elastic sponge rubber. It will take hundreds of thousands of compressions without matting down. The perfect sponge rubber for your routine *and problem* jobs, Kem-Blo can be made to meet your specifications... for size... for performance... in any width, compression, shape and thickness. Choice of many colors, too.

Order your file-fitting Kem-Blo Swatch book *today!* Write: U. S. Kem-Blo Dept. at address below.

US RUBBER **United States Rubber**
Naugatuck, Conn

VELLUMOID

VELLUMOID for Vital Sealing Jobs

Because of Vellumoid's long experience in manufacturing the exact gasket for so many various jobs, design engineers specify Vellumoid Materials ***to be sure.*** The Vellumoid sales engineer in your territory will gladly work with your design group to be sure you get the correct gasket ***every*** time.

Specify Vellumoid Materials for a perfect seal!

THE VELLUMOID COMPANY
Worcester, Massachusetts

Service Manager for truck rental fleet in Kearny, N. J. Apply by letter, telephone, or in person to L. Huttinger, County Line Rental Co., 3rd & Central Ave., S. Kearny, New Jersey. Phone—Newark, MArket 3-6653.

What's your clamping problem?

WITTEK has the answer



Auto Clamp | Type GM | Sure-Tite

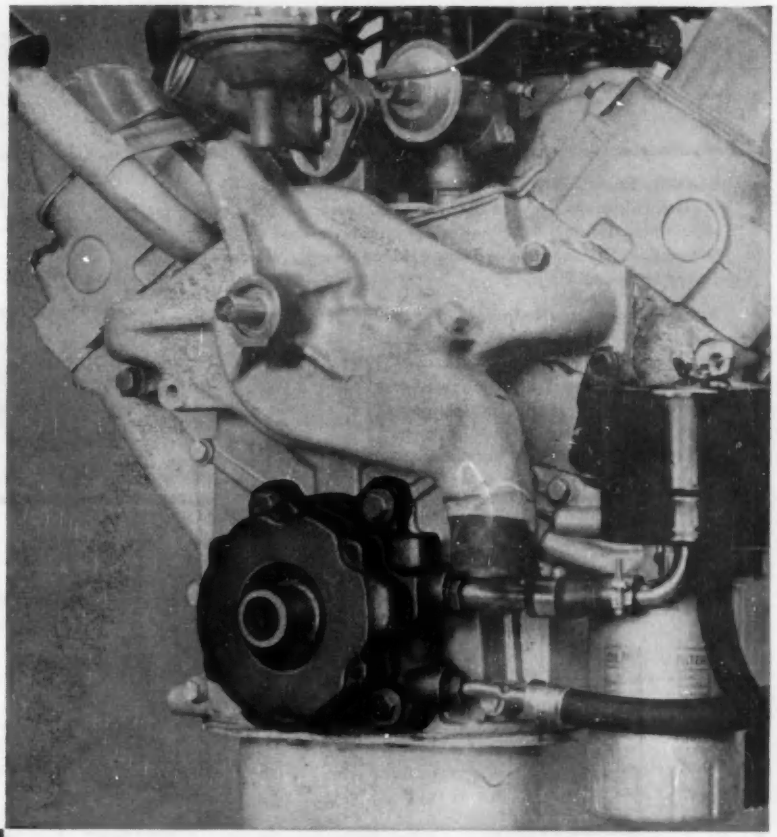
Here's a selection from among the many different types and sizes of hose clamps designed and manufactured by Wittek (leader for over a quarter century). Let Wittek solve *your* clamping problems. Write today.

WITTEK MANUFACTURING CO.
4342 West 24th Place • Chicago 23, Illinois

7009

saving
accessory
space

on the 1958
Mercury





new VICKERS
direct crankshaft-driven
power steering pump

Designed to be an integral part of the engine, this Vickers advanced design power steering pump mounts on the engine front cover for direct crankshaft drive. Elimination of mounting bracket and V-belt drive saves vital engine compartment space and simplifies power transmission problems. The direct crankshaft drive also assures power for steering under all conditions.

This new pump, incorporating time tested Vickers features, is a result of coordinated teamwork between automotive manufacturer and supplier . . . the kind of teamwork that builds great products.

VICKERS INCORPORATED
DIVISION OF SPERRY RAND CORPORATION
AUTOMOTIVE PRODUCTS DEPARTMENT
MOBILE HYDRAULICS DIVISION
ADMINISTRATIVE and ENGINEERING CENTER
DEPARTMENT 1440 • DETROIT 32, MICH.

MORE VICKERS TYPE VANE PUMPS
than all other makes
combined are used for
HYDRAULIC POWER STEERING

7972

ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

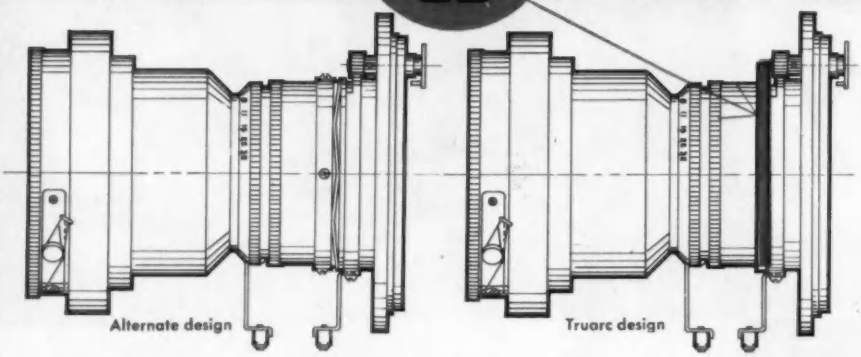
Waldes Truarc Retaining Ring eliminates 7 parts, saves $8.88 in sub-assembly of aerial reconnaissance camera

Gordon Enterprises, No. Hollywood, California, saved the Navy almost 1½ million dollars on 500 cameras. Gordon rebuilt new, efficient "CA" series out of Navy-owned obsolete models. Critical parts are now held together by Waldes Truarc Retaining Rings.

Truarc Rings are trouble-free, will not change position during operation. Accuracy is limited only by groove and ring dimension tolerances. And standardized Truarc Rings are quickly interchangeable in overhaul which now takes only 11 minutes, can be handled by unskilled technicians.







Truarc 5100-287 ring retains shutter speed adjustment mechanism on the Lens Adapter Plate Assembly which mounts and locks the lens and shutter assemblies accurately to camera body. Alternate design required retaining washer, spring, collar and 4 locking screws.

Weight Saving: 7.25 oz.

Assembly Time Saving: . . . . . 6½ min.

DOLLAR SAVINGS:

Material	**$ .93**
Fabrication	**6.88**
Inspection	**1.07**
Total	**$8.88**

Whatever you make, there's a Waldes Truarc Ring designed to save you material, machining and labor costs, and to improve the functioning of your product.

In Truarc, you get

Complete Selection: 36 functionally different types. As many as 97 standard sizes within a ring type. 5 metal specifications and 14 different finishes. All types available quickly from leading OEM distributors in 90 stocking points throughout the U.S. and Canada.

Controlled Quality from engineering and raw materials through to the finished product. Every step in manufacture watched and checked in Waldes' own modern plant.

Field Engineering Service: More than 30 engineering-minded factory representatives and 700 field men are at your call.

Design and Engineering Service not only helps you select the proper type of ring for your purpose, but also helps you use it most efficiently. Send us your blueprints today...let our Truarc engineers help you solve design, assembly and production problems...without obligation.

For precision internal grooving and undercutting . . . Waldes Truarc Grooving Tool!



WALDES

TRUARC®

RETAINING RINGS

WALDES KOHINOOR, INC.

47-16 AUSTEL PLACE, L. I. C. 1, N. Y.

Waldes Kohinoor, Inc., 47-16 Austel Place, L.I.C. 1, N.Y.
Please send new, descriptive catalog showing all types of Truarc rings and representative case history applications. *(Please print)*

Name .....

Title .....

Company .....

Business Address .....

City ..... *Zone* ... *State* SA12

WALDES TRUARC Retaining Rings, Grooving Tools, Pliers, Applicators and Dispensers are protected by one or more of the following U. S. Patents: 2,382,948; 2,411,426; 2,411,761; 2,416,852; 2,420,921; 2,428,341; 2,439,785; 2,441,846; 2,455,165; 2,483,379; 2,483,380; 2,483,383; 2,487,802; 2,487,803; 2,491,306; 2,491,310; 2,509,081; 2,544,631; 2,546,616; 2,547,263; 2,558,704; 2,574,034; 2,577,319; 2,595,787, and other U. S. Patents pending. Equal patent protection established in foreign countries.



Young circular oil coolers

meet special requirements for Davey Hydrovane Compressors



YOUNG circular core design oil coolers are tailored to meet the specific requirements of the well-known Davey Hydrovane Compressor units. Incorporating Young exclusive, high efficiency patented turbulators, discharge air temperature is lowered as much as 100° below other types of compressors — proof of the efficiency of design and construction of this Young cooling unit.

As leaders in the field of heat transfer engineering, Young Radiator Company invites your inquiries. There is no obligation, and you will find that Young experience and knowledge usually reduce the "special" problem to one that can be solved with Young standard equipment. Write today to Dept. 117-M for catalog 148A.

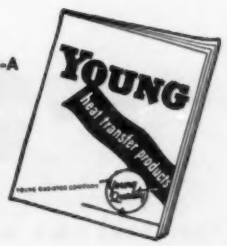
Young RADIATOR COMPANY

RACINE, WISCONSIN

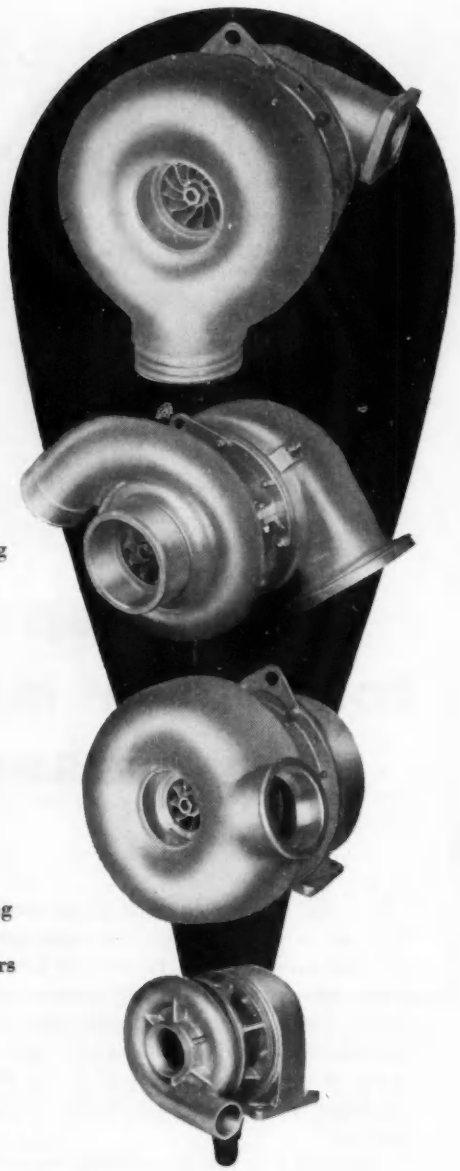
Creative HEAT TRANSFER ENGINEERS

Executive Office: Racine, Wisconsin, Plants at Racine, Wisconsin, Matteon, Illinois

Send for catalog No. 148-A today. There is no obligation. Write to Dept. 117-M



AIRESEARCH TURBOCHARGERS ANSWER "YES!" TO...



increased power?

Your engine's output can be raised up to 100%, depending on its design and application. Incorporating the most efficient turbine wheels in the industry, AiResearch turbochargers can give sea-level performance up to 12,000 feet.

lower specific fuel consumption?

The turbocharger improves engine combustion, resulting in important fuel saving per horsepower even with greatly increased engine power output.

lower engine thermal loading?

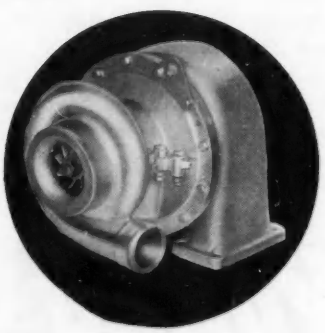
Efficient compressor wheel design holds heat-producing turbulence to a minimum, providing a smooth flow of compressed air to the engine. AiResearch turbochargers are also air-cooled, eliminating the need for complicated plumbing.

less noise and smoke?

Engine noise level is greatly decreased. Smoking is often completely eliminated.

reliability and durability?

Excellent reports on more than 13,000 AiResearch units at work in the field emphasize these qualities. AiResearch turbochargers require no attention between normal engine overhaul periods.



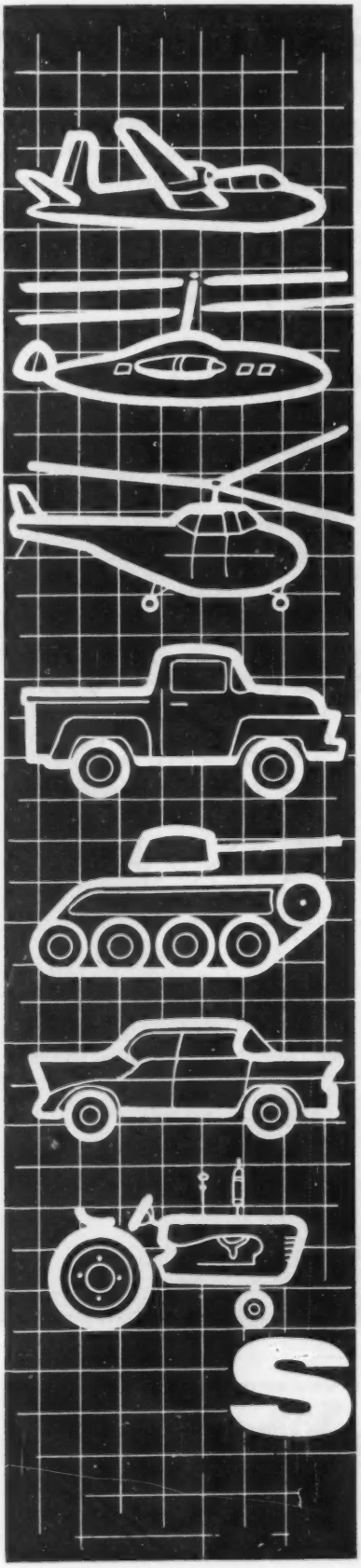
Your inquiries are invited.

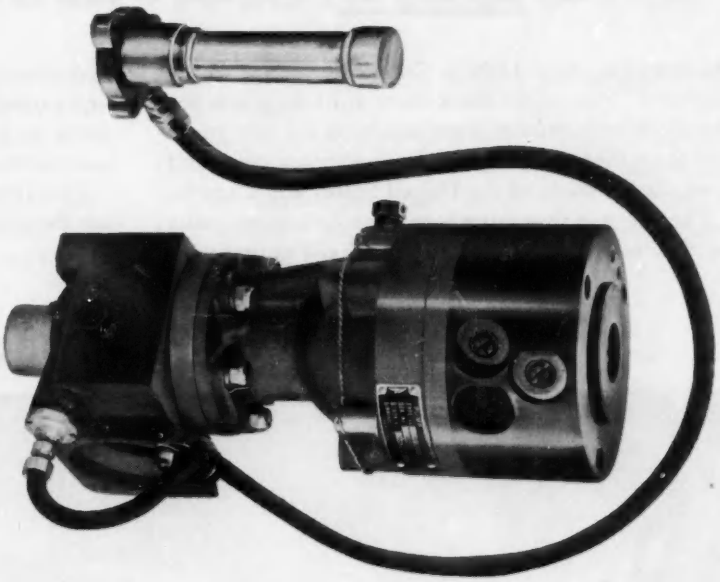
THE GARRETT CORPORATION

AiResearch Industrial Division

9225 South Aviation Blvd., Los Angeles 45, California

DESIGNERS AND MANUFACTURERS OF TURBOCHARGERS AND SPECIALIZED INDUSTRIAL PRODUCTS





SIMMONDS

Fuel Injection Systems in Full Production for Gasoline Engines

After several years of rigorous tests under extreme conditions of weather and environment, the Simmonds SU Fuel Injection System has been put into full production for U. S. Ordnance engines.

The System is being adapted to engines in all horsepower ranges for use in passenger cars, trucks, buses, marine and farm equipment, earth and snow moving equipment.

The Simmonds SU Fuel Injection System is a multiple point, low-pressure, timed speed-density injection system offering these definite advantages: it overcomes major icing problems; it improves cold starts; it eliminates the need of hot-spots and preheaters with a resulting increase in power output; it compensates for variations in barometric pressure, altitude and intake air temperature. The System also provides improved fuel distribution resulting in better cylinder head cooling – its operation is unaffected by engine attitude.

Detailed information on SU Fuel Injection Systems is now available. Write on your company letterhead for literature.

Simmonds AEROCESSORIES, INC.

General Offices: Tarrytown, N. Y. • Branch Offices: Dayton, Ohio • Detroit, Mich. • St. Louis, Mo. • Dallas, Texas • Wichita, Kans. • Glendale, Cal. • Seattle, Wash. • Sole Canadian Licensee: Simmonds Aerocessories of Canada Limited — Montreal

Two extra reasons truckers always

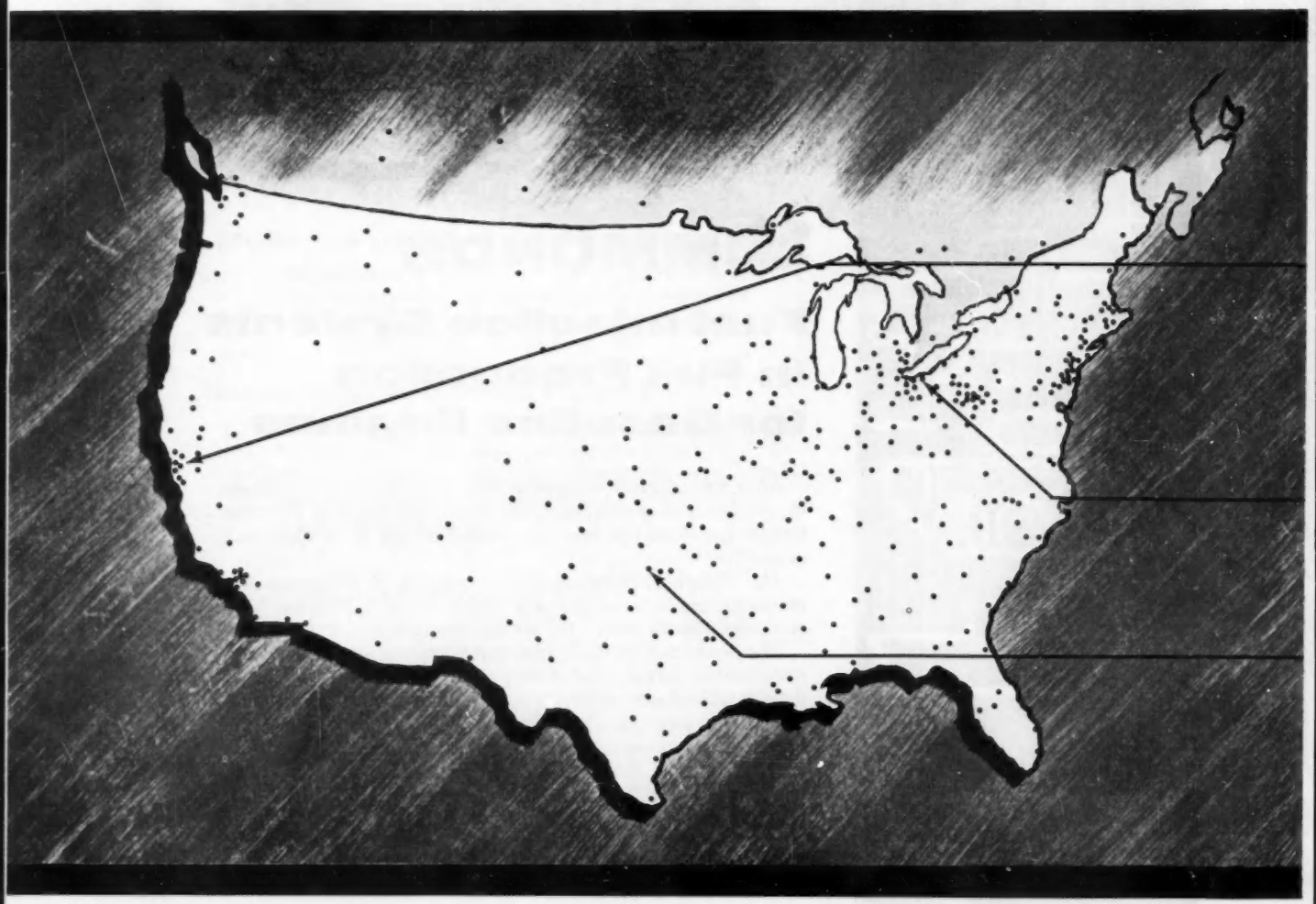
Monroeville, New Lisbon, Seminole. Know where they are?* You might think these unlikely places for Bendix-Westinghouse distributors to be. But you'll find them there. And in hundreds of other cities and towns in all parts of the United States and Canada.

The point is that anywhere your customers' units go they're never far from a Bendix-Westinghouse distributor with trained air brake equipment experts and a complete stock of replacement units and service parts to handle any maintenance or repairs your customers may need.

This is an extra advantage they get *only* when they use Bendix-Westinghouse Air Brakes.

*In Ohio, Wisconsin and Oklahoma respectively

first in sales and service



BENDIX-WESTINGHOUSE AIR BRAKES
AUTHORIZED DISTRIBUTOR SALES - SERVICE

Truckers always look for this illuminated sign . . .

Or check the classified pages in their phone book

BENDIX-WESTINGHOUSE AIR BRAKES
SALES—SERVICE GENUINE FACTORY RECONDITIONED UNITS
"WHERE TO BUY THEM"

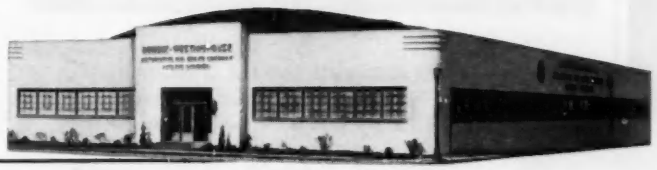
specify BENDIX-WESTINGHOUSE

If you were to check the list over the years, you'd find Bendix-Westinghouse has shown the way consistently in the developments that have meant constantly better and better air brakes.

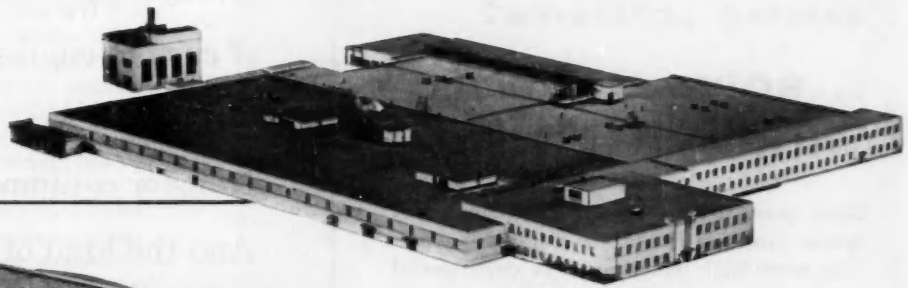
If you could check operating costs per mile across the country, you'd find Bendix-Westinghouse Air Brakes way ahead in providing fleet operators and truck owners with better stops at lower cost for a longer time.

These facts are born of Bendix-Westinghouse research and manufacturing talents—and are two of the biggest reasons why *more trucks travel more miles with Bendix-Westinghouse than with all other air brakes combined!*

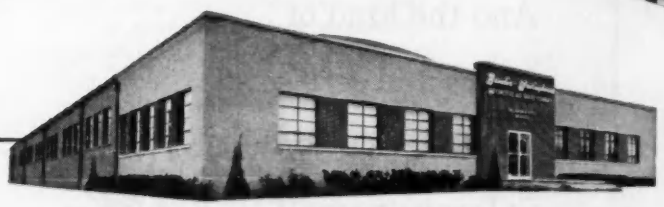
first in research and manufacturing



Berkeley, Calif., branch



General Offices and Factory—Elyria, Ohio



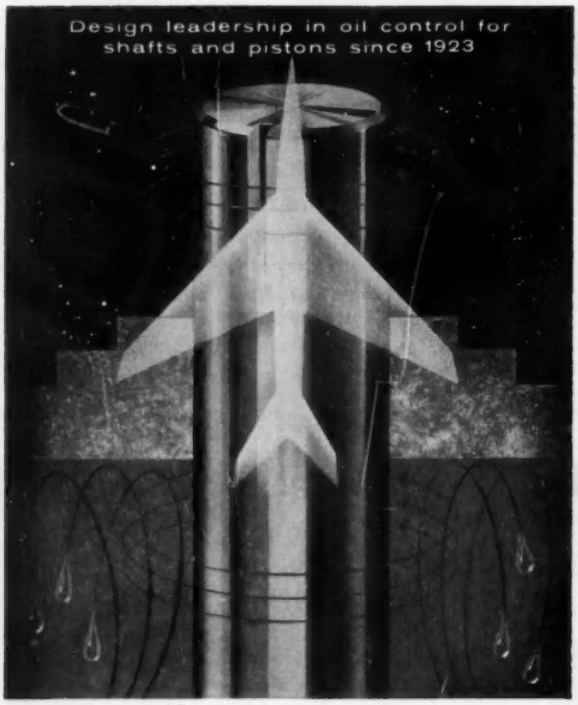
Oklahoma City, Okla., branch

Bendix-Westinghouse

AUTOMOTIVE AIR BRAKE COMPANY

BENDIX-WESTINGHOUSE AIR BRAKES®

AIR BRAKES



HIGH SPEED shaft sealing problems?

...solve them with SIMPLEX

Shaft speeds to 20,000 rpm and higher present special problems in shaft seal design — especially when high temperatures or other special conditions may also be involved.

To designers and builders of jet or reciprocating engines and auxiliaries, SIMPLEX offers exclusive design principles and extended industry experience in solving similar problems. SIMPLEX products are original equipment in Allison, Pratt & Whitney, Wright and other leading aircraft engines.

Whether your oil control problems involve shaft seals or piston rings, SIMPLEX engineers will be glad to help you work them out. Call, wire or write.

Simplex Piston Ring Mfg. Co.
12301 BENNINGTON AVENUE • CLEVELAND 11, OHIO
75 N. E. 74th STREET • MIAMI 38, FLORIDA

SIMPLEX
HIGH SPEED SHAFT SEALS
AND PISTON RINGS

HEAVY INDUSTRY ENGINES IN ACTION
KEEP COOL WITH
GENERAL RADIATOR



Fast quotes

...together with the best
of custom engineering
on your heat
transfer equipment.
And the kind of
prices and *service*...
whether your order
is large or small...
that make you a
steady "partner."

See us at the S.A.E. Show Booth 31, Jan. 13-17

Let us give you details.

Solving heat transfer problems through custom engineering

GENERAL RADIATOR —INC.—

MOUNT VERNON, ILLINOIS
Phone: 5180

GEN-5

STAINLESS STEEL MAKES THE DIFFERENCE

...its effect on modern trucking

Stainless steel sets new standards of performance for truck trailers. Experience proves that stainless outlasts and outwears other materials and is always easier to maintain.

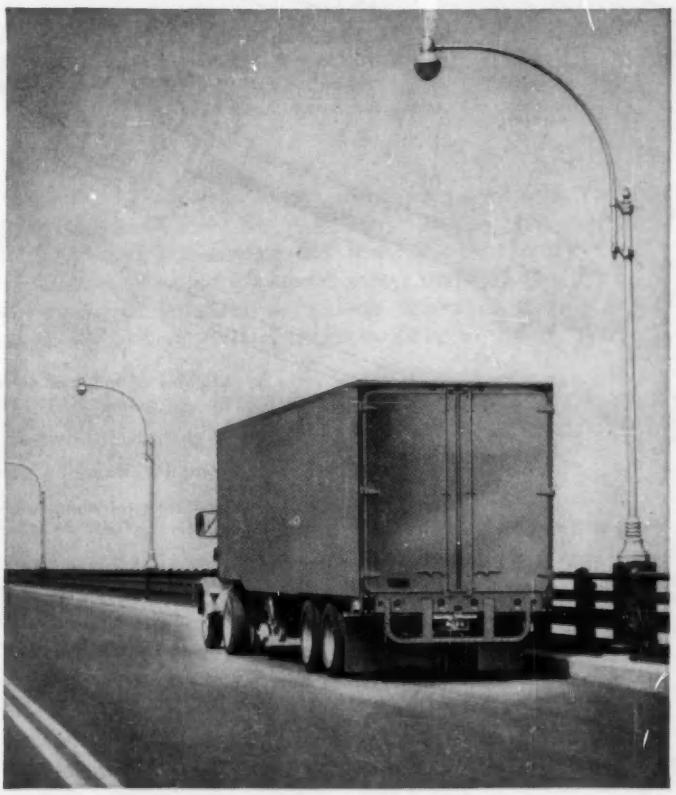
That's because stainless is practically immune to corrosion and rust. Its inherent toughness makes it hard to dent or scratch. Operating costs are less, too, because stainless needs no paint or special finish—the beautiful smooth surface is always quick and easy to clean. Extra strength lets you carry bigger payloads safely. No wonder more and more stainless steel units are going into service each year!

For more information about stainless steel and the many ways it can help improve your automotive products—see your stainless steel supplier or write ELECTROMET...leading producer of more than 100 alloys for the metal industries, including chromium and manganese used for making stainless steel. ELECTRO METALLURGICAL COMPANY, Division of Union Carbide Corporation, 30 E. 42nd Street, New York 17, N. Y. *In Canada:* Electro Metallurgical Company, Division of Union Carbide Canada Limited, Toronto.

METALS DO MORE ALL THE TIME ...THANKS TO ALLOYS

Electromet
FERRO-ALLOYS AND METALS

UNION CARBIDE



With stainless steel you never compromise on strength, durability or appearance. Stainless makes bigger payloads possible, yet outlasts other materials.

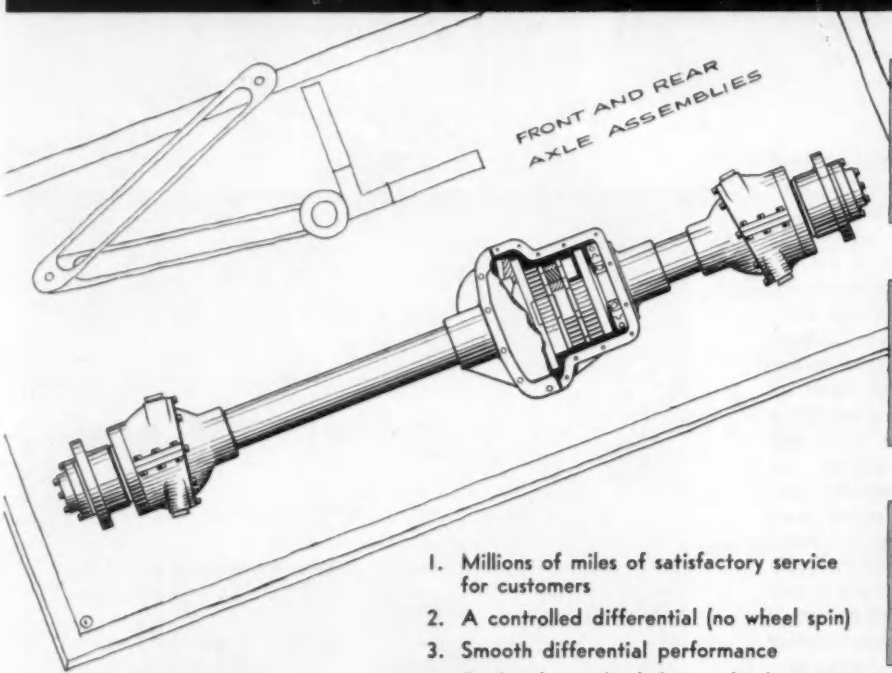
The terms "Electromet" and "Union Carbide" are registered trade-marks of Union Carbide Corporation.

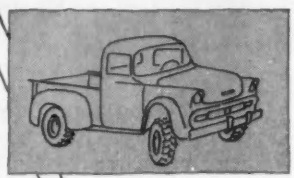
Complete Axle Assemblies

equipped with

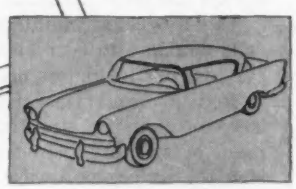
DUALOC POWER DIVIDING DIFFERENTIALS

Engineered to Your Specifications!

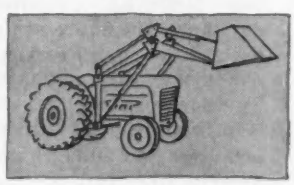




FOR TRUCKS



FOR CARS



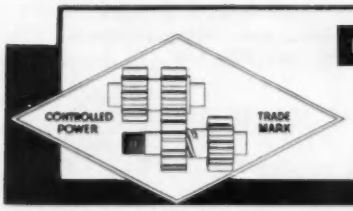
FOR TRACTORS

1. Millions of miles of satisfactory service for customers
2. A controlled differential (no wheel spin)
3. Smooth differential performance
4. Dualoc front-wheel drive axles have no adverse effects on steering

**EXECUTIVES-
DESIGN
ENGINEERS**

SEE THE DUALOC POWER-DIVIDING AXLE ON DISPLAY —BOOTH #5 S.A.E. EXHIBIT, JANUARY 13 TO 17, SHERATON CADILLAC HOTEL, DETROIT, MICHIGAN.

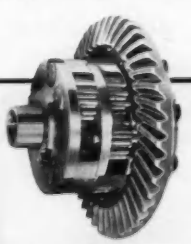
Dualoc power-dividing axles provide more usable traction for tractors, trucks and off-the-road equipment. They provide greater safety and convenience for passenger cars. Annoying stalls resulting from one wheel spinning in mud, snow and on icy surfaces are eliminated by transfer of power between wheels controlled by Dualoc power-dividing differential.



Dualoc Drive, inc.

700-20th St., Rockford, Ill.

Manufacturers of Fine
Power-dividing Differentials





New resilient facings transmit torque with fewer clutch plates

A new group of Armstrong friction materials, developed for use at high closing pressures, now permits designers to reduce the number of friction surfaces in a transmission with no sacrifice in torque capacity.

Such a reduction, of course, offers savings in friction material, metal, fabricating and assembly costs, as well as a means of cutting down the size of the transmission.

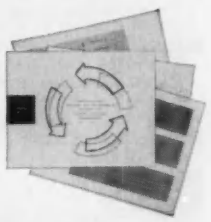
Two major factors make these savings possible. First, the new materials have inherently high coefficients of friction. Second, and more important, they are made to operate at the higher closing pressures formerly restricted to inorganic materials. These new facings are now operating successfully in automatic transmissions with pressures in the range of 350 to 400 psi.

At these higher pressures, the new materials show virtually no loss in coefficient of friction during their service life. They have been specified for wide use in the automatic transmissions of 1958 cars.

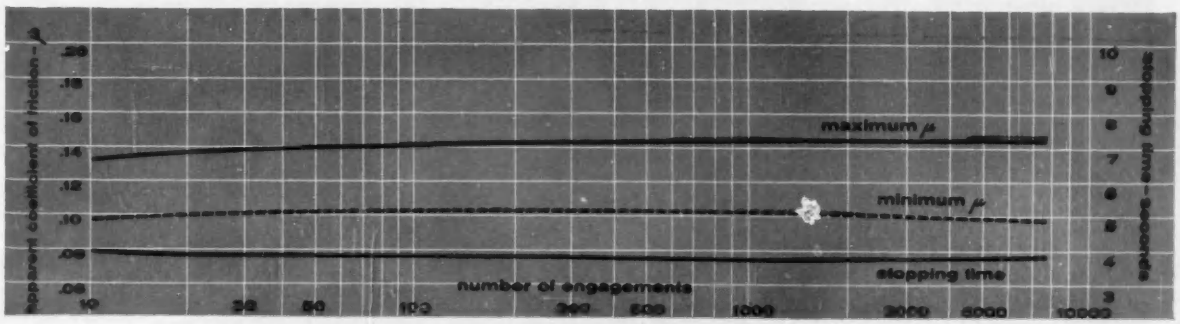
Laboratory tests, described below, demonstrate the high fade resistance of these new materials.

Send for free booklet

For more details and performance data on these new materials, write for your copy of booklet IND-953. Armstrong Cork Company, 7212 Durham Street, Lancaster, Penna.



Fade curves like those shown below are derived from dynamometer tests conducted at the Armstrong Research and Development Center. In these tests, a single clutch plate (7½" O.D., 6½" I.D., faced both sides) is engaged and disengaged thousands of times, each time absorbing the 28,000 foot-pounds of kinetic energy which the dynamometer develops at 1000 rpm. During each engagement, the three factors noted on the curves are graphically recorded. Ideally, each of the three curves would be horizontal.



Armstrong FM-45, one of the new materials, produced this set of fade curves during dynamometer tests. Maximum coefficient of friction, minimum coefficient of friction, and stopping time for each of 7,500 engagements are plotted here to indicate how much these factors varied during the course of the test. Note that the curves are practically horizontal and that frictional characteristics, accordingly, have remained virtually constant.

Armstrong RESILIENT FRICTION MATERIALS

... used wherever performance counts

+ INDEX TO ADVERTISERS +

A

Acro Div., Robertshaw Fulton Controls Corp. 108
AiResearch Mfg Co. 132, 196
Allison Div., General Motors Corp. Inside Back Cover
Aluminum Co. of America 178, 179
American Bosch Div., American Bosch Arma Corp. 118
American Brakeblok Div., American Brake Shoe Co. 18
American Chemical Paint Co. 136
American Felt Co. 206
Anchor Coupling Co., Inc. 98
Armstrong Cork Co. 130, 203
Associated Spring Corp. 184, 185
Athol Mfg. Co. 104
Auto Radiator Mfg. Co. 122

B

Bendix Aviation Corp.
Products (General Sales) Div. 24
Eclipse Machine-Stromberg Elmira 172
Shows and Exhibits 135
Bendix Westinghouse Automotive Air Brake Co. 198, 199
Berman Sales Co. 192
Bethlehem Steel Co. 119
Blood Brothers Machine Div., Rockwell Spring & Axle Co. 142
Bohn Aluminum & Brass Corp. 101
Borg & Beck Div., Borg-Warner Corp. 126
Bower Roller Bearing Div., Federal-Mogul-Bower-Bearings, Inc. 169
Bridgeport Brass Co. 205
Brooks and Perkins, Inc. 116
Bundy Tubing Co. 146, 147
Burgess-Norton Mfg. Co. 112, 113

C

Campbell, Wyant & Cannon Foundry Co. 102
Carter Carburetor Div., A. C. F. Industries 187
Chevrolet Div., General Motors Corp. 109
Chicago Rawhide Mfg. Co. 190
Chicago Screw Co. 105
Chrysler Corp. 10
Clark Equipment Co. 170
Continental Motors Corp. 124

D

Dana Corp. 173, 174
Delco Radio Div., General Motors Corp. 143
DeSoto Div., Chrysler Corp. 107
Detroit Aluminum & Brass Corp. 111
Dodge Div., Chrysler Corp. 19
Doehler Jarvis Div., National Lead Co. 150, 151
Dow Chemical Co. 141
Dow Corning Corp. 158
Dualoc Drive, Inc. 202
E. I. du Pont de Nemours & Co., Inc., Elastomer Chemicals 183

E

Eaton Mfg. Co., Valve Div. 22
Elastic Stop Nut Corp. 175
Electro Metallurgical Co., Div., Union Carbide Corp. 201
Enjay Co., Inc. 154, 191

F

Fabricon Products, Inc. 128
Fafnir Bearing Co. 134
Federal Mogul Div., Federal-Mogul-Bower-Bearings, Inc. 176
Fram Corp. 140

G

General Motors Corp. 8
General Radiator, Inc. 200
Goodyear Tire & Rubber Co., Inc. Metal Products 9
Great Lakes Steel Corp. 165

H

Harrison Radiator Div., General Motors Corp. 17
Heim Co. 148
Hoover Ball & Bearing Co. 155
Hyatt Bearings Div., General Motors Corp. 97

I

International Harvester Co. 12, 13
International Nickel Co. 127
International Packings Corp. 16

J

Johnson Bronze Co. 159

L

Linde Co., Div. of Union Carbide Corp. 125
Lipe Rollway Corp. 139
Luber-Finer, Inc. 115

M

McLouth Steel Corp. 162
MB Mfg. Co., Inc. 99
Mechanics Universal Joint Div. Borg Warner Corp. 149
Midland Steel Products Co. 103, 117
Moraine Products Div., General Motors Corp. 145
Morse Chain Co. "A Borg-Warner Industry" 182

N

National Analine Div., Allied Chemical & Dye Corp. 181
National Seal Div., Federal Mogul-Bower-Bearings Co., Inc. 11
National Standard Co. 171
New Departure Div., General Motors Corp. 7

O

Oldsmobile Div., General Motors Corp. 15

P

Palnut Co., Subsidiary of United-Carr Fastener Corp. 110
Park Drop Forge Co. 96
Perfect Circle Corp. Inside Front Cover
Phoenix Mfg. Co. 186
Pioneer Aluminum Supply Co. 123
Pontiac Motor Div., General Motors Corp. 120
Precision Rubber Products Corp. 3
Purolator Products, Inc. 129

R

Reynolds Metals Co. 137, 138
Rochester Products Div., General Motors Corp. 189
Rockford Clutch Div., Borg Warner Corp. 100

S

Saginaw Steering Gear Div., General Motors Corp. 114
Sealed Power Corp. 164
Shell Chemical Corp. 161
Simmonds Aerocessories, Inc. 197
Simplex Piston Ring Co. 200
SKF Industries, Inc. 167
A. O. Smith Corp. 20, 21
Sparta Foundry Co. 157
Spherco Bearings Div., Stephens-Adamson Mfg. Co. 116
Stackpole Carbon Co. 121
Standard Pressed Steel Co. 166
Sterling Aluminum Products, Inc. 144
Sun Oil Co. 4

T

Timken Detroit Axle Div., Rockwell Spring & Axle Corp. 152, 153
Timken Roller Bearing Co. Outside Back Cover
Torrington Co. 131
Tung Sol Electric, Inc. 106
Twin Disc Clutch Co. 160

U

Union Carbide Corp.
Electro Metallurgical Co. 201
Linde Co. 125
United Carr Fastener Corp. 163
U. S. Rubber Co. (Naugatuck Chemicals) 192

V

Vanadium Corp. of America 133
Veeder-Root, Inc. 177
Vellumoid Co. 192
Vickers, Inc., Div. of Sperry Rand Corp. 193

W

Wagner Electric Corp. 180
Waldes-Kohinoor, Inc. 194
Washington Steel Corp. 168
Western Felt Works 156
S. S. White Dental Mfg. Co. 14
Wittek Mfg. Co. 192
Wyman-Gordon Co. 188

Y

Young Radiator Co. 195

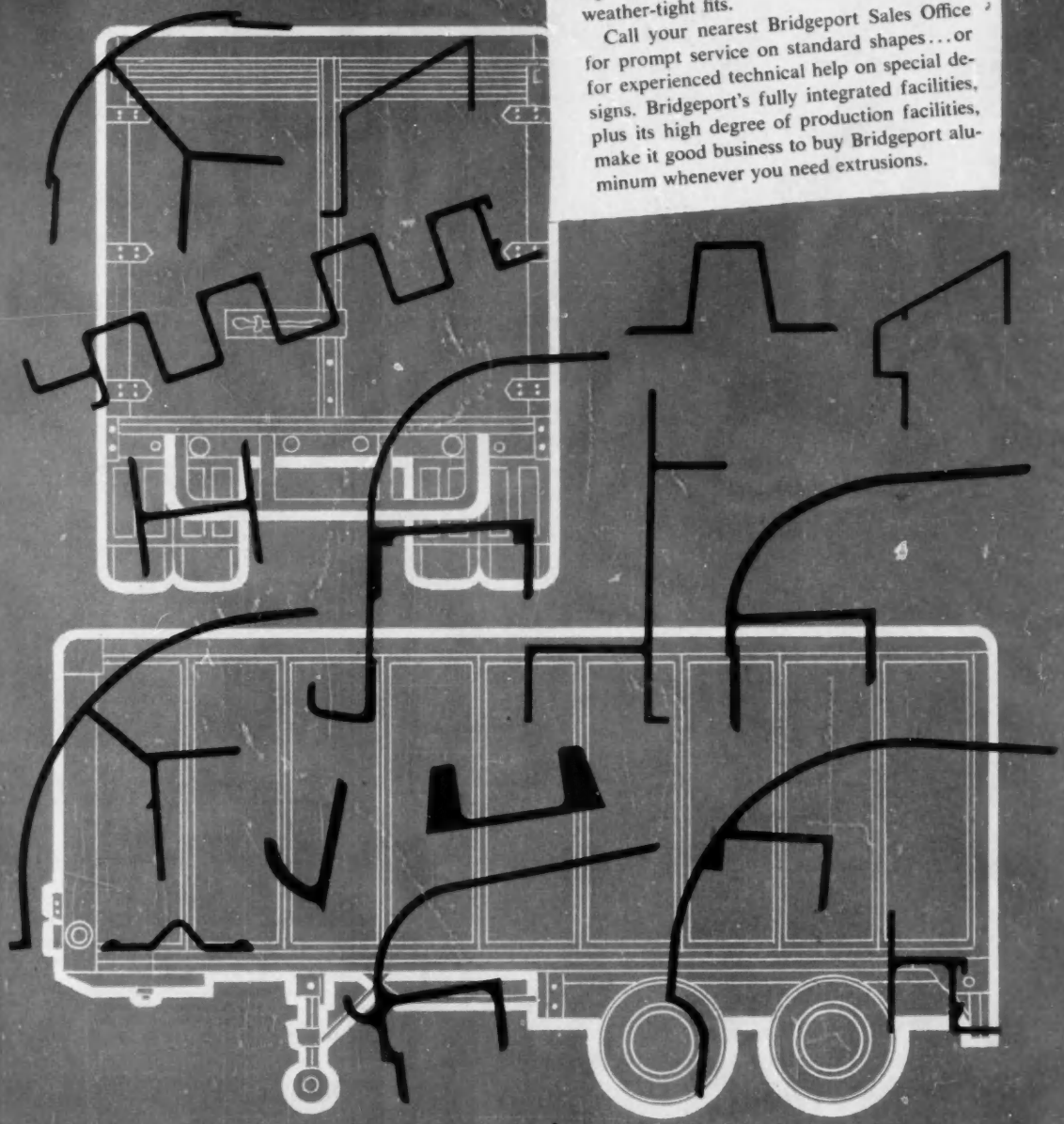
FOR DEPENDABLE CAR PERFORMANCE

BLUEPRINT FOR PROFIT

The shapes shown here are just a few of Bridgeport's wide range of standard aluminum extrusions for truck and trailer bodies—all available without die charge.

You'll do well to specify Bridgeport. Bridgeport shapes are engineered to meet the most precise design and production requirements, combining light weight, strength and rigidity with fast, easy assembly for secure weather-tight fits.

Call your nearest Bridgeport Sales Office for prompt service on standard shapes... or for experienced technical help on special designs. Bridgeport's fully integrated facilities, plus its high degree of production facilities, make it good business to buy Bridgeport aluminum whenever you need extrusions.



For the very newest in

Bridgeport BRASS CO

BRIDGEPORT ALUMINUM

Aluminum Extrusion and Forging Facilities at Adrian, Michigan

FOR DEPENDABLE CAR PERFORMANCE, THESE VITAL SPOTS DEMAND THE DEPENDABILITY OF AMERICAN QUALITY FELTS

Lubrication—Sealing—Insulating—Cushioning—Anti-Rattle—Anti-Squeak—Sound Absorption
Polishing—Silencing—Washers—Gaskets—Liners—Channels—Weatherstrip—Packing—Filtration

1 FAN BEARING OILER. 2 WATER PUMP PACKING AND OILER. 3 GENERATOR BEARING SEALS. 4 GENERATOR AND STARTER LUBRICATING WICKS. 5 OIL FILTER. 6 BATTERY POSITIVE TERMINAL ANTI-CORROSION WASHER. 7 BRAKE BOLT OILER. 8 STEERING KNUCKLE TO TIE ROD DUST SEAL AND FLANGE JOINT SEAL. 9 STEERING ARM BEARING OILER. 10 FRONT WHEEL BEARING SEAL. 11 WHEEL BRAKE SHOE OILER. 12 CARBURETOR. 13 STEERING COLUMN GROMMET. 14 TRANSMISSION OIL SEAL WASHER. (SEAL ASSEMBLY TRANSMISSION BEARING) 15 DRIVE SHAFT DUST SEAL. 16 TOE BOARD AND FLOOR BOARD LINER. 17 CLUTCH HOUSING PAN DUST SEAL. 18 BODY TO CHASSIS STRIPS. 19 WINDSHIELD WIPER PIVOT ARM MOUNTING. 20 WINDOW LIFT LUBRICATORS. 21 DOOR PANEL INSULATOR. 22 FLOOR BOARD PARTS. 23 UNIVERSAL OIL SEAL. 24 TURRET TOP INSULATION. 25 WINDOW RUN CHANNEL. 26 REAR AXLE DRIVE SHAFT SEAL. 27 AXLE PINION DRIVE BEARING SEAL. 28 UPHOLSTERY RISER STRIPS. 29 SPRING COVER LINING. 30 REAR PANEL WEATHERSTRIP. 31 FUEL TANK STRAP GASKET.



Write for S.A.E. Data Sheet No. 5, containing samples and full specifications of the standard S.A.E. Felts.

American Felt Company
TRADE MARK

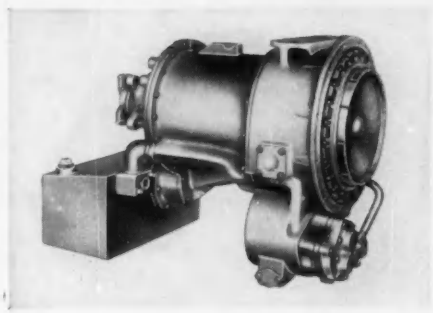
GENERAL OFFICES: 5 GLENVILLE ROAD, GLENVILLE, CONN.

SALES OFFICES: New York, Boston, Chicago, Detroit, Cleveland, Rochester, Philadelphia, St. Louis, Atlanta, Greenville, S. C., Dallas, Boynton Beach, Fla., San Francisco, Los Angeles, Portland, San Diego, Seattle, Montreal.—PLANTS: Glenville, Conn.; Franklin, Mass.; Newburgh, N. Y.; Detroit, Mich.; Westerly, R. I.—ENGINEERING AND RESEARCH LABORATORIES: Glenville, Conn.

Some Additional Applications of felt: Clutch release link lever oiler • Window anti-squeak • Fuel tank support lining • Brake shoe anchor pin washer • Drag link dust cover • Intermediate steering arm bearing seal • Windshield wiper motor washer • Toe and floor board anti-squeak • Solenoid cover gasket • Heater core to housing filler • Spindle bolt grease retainer • Spindle bolt dust washers • Radius rod felt • Hydraulic lift spring seat • Door bumpers • Pedal pads and seals • Dash liners • Oil retainers • Polishing felts, for glass, metal and paint • Door liners • Ventilator valve seals • Weather seals • Hood lace filler • Moulding shim • Timing gear cover pad • Accelerator rod pad • Fuel tank shim • Propeller shaft spline oiler • Paint filter bags • Crankcase oil filter cap • Brake dirt seals • Defroster control valve seal • Hand brake cable clamp seal • Windshield division filler • Pinion bearing retainer packing • Horn wire locator felt • Oil sabre dust washer • Fender welt felt • Spring oiler felt • Spring bumpers • Gas filling protector pads • Rocker arm seals • Chafing strips for convertible tops • Upholstery padding • Radio selector pads • Thrust bearing inserts • Cab roof lining • Antenna weather seal • Blankets for protection during assembly and service • Factory table pads • Glycerine pads for windshield wipers •

Entire Advertisement © 1937, American Felt Co.

New way to pinpoint a payload



Never Before

Newpedal-operated inching control permits positioning of the load with pinpoint accuracy in either forward or reverse range.

Now Allison TORQMATIC DRIVE brings new power, ease and precision to big fork-lift trucks

Now, for the first time, here is a full power-shift transmission for giant fork-lift trucks.

It's the new TORQMATIC CRT-3331-3—specially designed to handle maximum engine torque in vehicles with limited chassis space, such as fork-lifts, underground ore carriers and other material handlers.

Its converter multiplies engine torque up to 350%—delivers this power with silken smoothness—eliminates load-tipping jolts.

Its proved-on-the-job planetary transmission lets you shift under full power in all speeds—3 forward and 3 reverse—for faster work cycles.

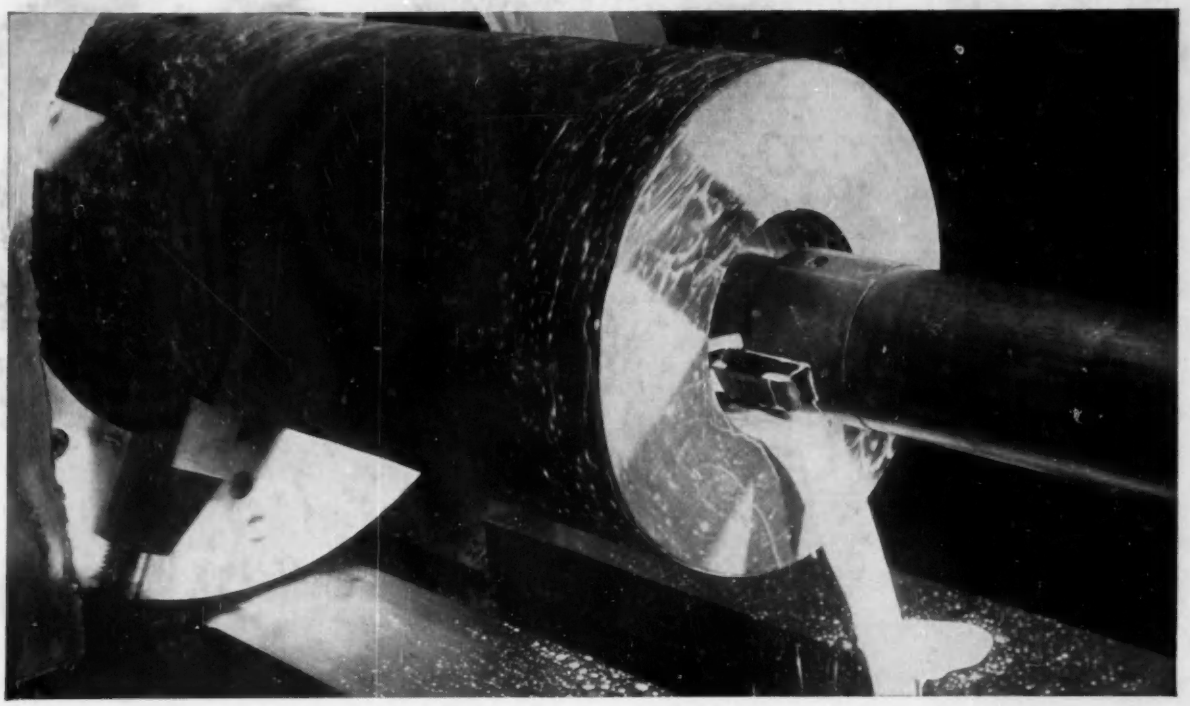
The exclusive oil-cushioned inching control permits enviable precision and accuracy—saves you time, money and equipment.

For truly modern, materials handling equipment, it will pay you to get the Allison TORQMATIC story.

Ask your equipment dealer, or write:

ALLISON DIVISION OF GENERAL MOTORS, Indianapolis 6, Indiana

Allison TORQMATIC DRIVES



Finish boring is your first step with Timken® seamless steel tubing —the hole's already there!

YOU save time and money when you make hollow parts with Timken® seamless steel tubing instead of bar stock. You eliminate drilling because the hole's already there. Finish boring is your first production step. With less metal to machine away you get more parts per ton of steel.

And because Timken seamless steel tubing eliminates one boring operation, your screw machine stations are free for other jobs. You get more machining capacity without adding machines.

And you get a better quality finished product with Timken seamless steel tubing because of the way we make it. A solid round is forged over a mandrel, thoroughly working the metal inside and out. This rotary piercing operation gives Timken seamless steel tubing its fine forged quality, uniform spiral grain flow. With exacting control of temperature and piercing speed, we maintain this quality from tube to tube, heat to heat, order to order.

And to further increase your steel savings, Timken Company engineers will be glad to recommend the most economical tube size for your hollow parts job. You'll get a size guaranteed to clean up to your dimensions. The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable: "TIMROSCO".

TIMKEN *Fine Alloy* **STEEL**

TRADE-MARK REG. U. S. PAT. OFF.

SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS STEEL TUBING